98th Congress
2d Session

JOINT COMMITTEE PRINT

S. PRT. APP. 10
98-164

HARD CHOICES

A Report on the Increasing Gap Between America's Infrastructure Needs and Our Ability To Pay for Them

---

Appendix 10. MASSACHUSETTS

A CASE STUDY

PREPARED FOR THE USE OF THE

SUBCOMMITTEE ON ECONOMIC GOALS AND INTERGOVERNMENTAL POLICY

OF THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

FEBRUARY 25, 1984

Printed for the use of the Joint Economic Committee

U.S. GOVERNMENT PRINTING OFFICE
31-895 O WASHINGTON: 1984

J842-17

JOINT ECONOMIC COMMITTEE

(Created pursuant to sec. 5(a) of Public Law 304, 79th Congress)

SENATE	HOUSE OF REPRESENTATIVES
ROGER W. JEPSEN, Iowa, *Chairman*	LEE H. HAMILTON, Indiana, *Vice Chairman*
WILLIAM V. ROTH, Jr., Delaware	GILLIS W. LONG, Louisiana
JAMES ABDNOR, South Dakota	PARREN J. MITCHELL, Maryland
STEVEN D. SYMMS, Idaho	AUGUSTUS F. HAWKINS, California
MACK MATTINGLY, Georgia	DAVID R. OBEY, Wisconsin
ALFONSE M. D'AMATO, New York	JAMES H. SCHEUER, New York
LLOYD BENTSEN, Texas	CHALMERS P. WYLIE, Ohio
WILLIAM PROXMIRE, Wisconsin	MARJORIE S. HOLT, Maryland
EDWARD M. KENNEDY, Massachusetts	DAN LUNGREN, California
PAUL S. SARBANES, Maryland	OLYMPIA J. SNOWE, Maine

BRUCE R. BARTLETT, *Executive Director*
JAMES K. GALBRAITH, *Deputy Director*

SUBCOMMITTEE ON ECONOMIC GOALS AND INTERGOVERNMENTAL POLICY

HOUSE OF REPRESENTATIVES	SENATE
LEE H. HAMILTON, Indiana, *Chairman*	LLOYD BENTSEN, Texas, *Vice Chairman*
AUGUSTUS F. HAWKINS, California	ROGER W. JEPSEN, Iowa
OLYMPIA J. SNOWE, Maine	ALFONSE M. D'AMATO, New York

Preface

Infrastructure problems are widespread. They do not respect regional or state boundaries. To secure a better data base concerning national and state infrastructure conditions and to develop threshold estimates of national and state infrastructure conditions, the Joint Economic Committee of the Congress requested that the University of Colorado's Graduate School of Public Affairs direct a twenty-three state infrastructure study. Simultaneously, the JEC appointed a National Infrastructure Advisory Committee to monitor study progress, review study findings and help develop policy recommendations to the Congress.

In almost all cases, the studies were prepared by principal analysts from a university or college within the state, following a design developed by the University of Colorado. Close collaboration was required and was received from the Governor's staff and relevant state agencies.

Because of fiscal constraints each participating university or college agreed to forego normal overhead and each researcher agreed to contribute considerable time to the analysis. Both are to be commended for their commitment to a unique and important national effort for the Congress of the United States.

National Infrastructure Advisory Committee
Joint Economic Committee Infrastructure Project

Chairman

Honorable Henry S. Reuss
former Chairman Joint Economic Committee
Chapman, Duff & Paul
Washington, D.C. 20006

Vice Chairmen

Mr. Peter Goldmark
Executive Director
Port Authority of N.Y. & N.J.
New York, N.Y.

Mr. Lee White
Vice President & Manager
Denver Office
Smith Barney, Harris Upham & Co.
Denver, Colorado

Committee Members

Mr. Roy Bahl
Director, Metropolitan Studies Program
Syracuse University
Syracuse, N.Y.

Honorable Michael Dukakis
Governor of Massachusetts
Boston, Massachusetts

Mr. C. Phillip Baumel
Professor
Agricultural Economics
Iowa State University
Ames, Iowa

Mr. Robert Georgine
President
Building & Construction Trades
Washington, D.C.

Mr. Michael Brewer
Director of Government Relations/
Public Affairs
Cummins Engine Co.
Columbus, Indiana

Mr. Hyman Grossman
Vice President, Municipal Rating
Standard & Poor's Corp.
New York, N.Y.

Mr. Pat Choate
Senior Policy Analyst, Economics
TRW, Inc.
Washington, D.C.

Honorable William Hobby
Lt. Governor of Texas
Austin, Texas

Mr. Peter M. Dawkins
Managing Director
Lehman Brothers Kuhn Loeb, Inc.
New York, N.Y.

Honorable Thomas H. Kean
Governor of New Jersey
Trenton, New Jersey

Mr. Thomas Klutznick
Miller, Klutznick, Davis & Grey
Chicago, Illinois

Ms. Juanita Kreps
Former U.S. Secretary of Commerce
Duke University
Durham, N.C.

Honorable Richard D. Lamm
Governor of Colorado
Denver, Colorado

Mr. Peter Lewis
Partner
Lazard Freres
New York, N.Y.

Ms. Jane McGrew
Steptoe & Johnson
Washington, D.C.

Honorable John Mutz
Lt. Governor of Indiana
Indianapolis, Indiana

Mr. Raymond Nasher
Chairman
Nasher Co.
Dallas, Texas

Mr. George Peterson
Director, Public Finance Center
The Urban Institute
Washington, D.C.

Mr. Leland S. Prussia
Chairman of the Board
Bank of America
San Francisco, Ca.

Honorable Charles Royer
Mayor
City of Seattle
Seattle, Washington

Mr. George Schrader
L.D. Brinkman & Co.
Dallas, Texas

Honorable Ted Schwinden
Governor of Montana
Helena, Montana

Honorable John Spellman
Governor of Washington
Olympia, Washington

Honorable Mark White
Governor of Texas
Austin, Texas

Mr. John Wiedeman
President
American Society of Civil Engineers
Atlanta, Georgia

Honorable Coleman A. Young
Mayor
City of Detroit
Detroit, Michigan

PARTICIPATING STATES AND RESEARCHERS

State	Researchers and Affiliation
Alabama	Niles Schoening University of Alabama
California	Fred Collignon University of California at Berkeley
Colorado	James Ohi University of Colorado at Denver
Florida	Earl Starnes Neil Sipe University of Florida
Indiana	Salmon Shah Morton Marcus Indiana University
Kentucky	Phillip W. Roeder Dennis B. Murphy University of Kentucky
Louisiana	James D. Schilling Louisiana State University
Maine	Carl Veazie University of Southern Maine
Maryland	David L. Puryear Johns Hopkins University
Massachusetts	Karen Polenske Gerald Sussman Richard Tabors Lyn Todman Adrian Walter Joint Center for Urban Policy Research MIT and Harvard University
Missouri	L. Kenneth Hubbell University of Missouri at Kansas City
Montana	James Ohi University of Colorado at Denver
New Jersey	Robert Lake Rutgers University
New Mexico	Lee Zink University of New Mexico

New York	Rae Zimmerman New York University
North Carolina	Edward Kaiser William J. Drummond Kathleen M. Heady University of North Carolina at Chapel Hill
Ohio	Michael Pagano Miami University
Oklahoma	Jean McDonald Tim Adams Tom Jones University of Oklahoma
Oregon	Ken Tollenoor University of Oregon
South Carolina	James Hite M.S. Henry B.L. Dillman Clemson University
Tennessee	Niles Schoening University of Alabama
Texas	William E. Claggert University of Texas at Dallas
Washington	Phillip Bourque University of Washington

AN ASSESSMENT OF PUBLIC INFRASTRUCTURE IN MASSACHUSETTS

April 1983

(Latest revision,
September 1983)

by

Karen R. Polenske, Gerald Sussman, Richard D. Tabors,
Lynn C. Todman, and Adrian R. Walter

Joint Center for Urban Studies
of the
Massachusetts Institute of Technology
and
Harvard University

TABLE OF CONTENTS

Title	Page
List of Figures	xv
List of Tables	xvi
List of Abbreviations	xviii
Acknowledgments	xix
AN ASSESSMENT OF PUBLIC INFRASTRUCTURE IN MASSACHUSETTS	1
Part 1, EXECUTIVE SUMMARY FOR MASSACHUSETTS	2
General Conclusions	2
Specific Conclusions	2
Part 2, BACKGROUND TO THE ANALYSIS	6
METHODS OF ANALYSIS	6
State Agencies	7
Regional Planning Commissions	13
CONTEXT FOR THE STUDY	15
Economic Factors	17
Population Trends	17
Part 3, TRANSPORTATION INFRASTRUCTURE	19
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY	19
Bus System	22
Facilities, Age, and Current Condition	22
Maintenance Plans and Costs	25
Purchase Plans and Costs	29
Rapid Transit	29
Facilities and Age	29
Construction Plans and Costs	31
The Green Line	35
Commuter Rail	37
Facilities	37
Maintenance Plans and Costs	38
Construction Plans and Costs	43

Title	Page
STATE-OWNED RAILROAD GRADES AND CROSSINGS	47
STATE-OWNED RAILROAD BRIDGES AND TUNNELS	47
REGIONAL TRANSIT AUTHORITIES	49
Facilities	49
Maintenance Plans and Costs	49
HIGHWAY BRIDGES	51
Facilities, Age, and Current Conditions	51
Maintenance Plans and Costs	55
Construction Plans and Costs	59
AIRPORTS	59
Facilities and Age	60
Maintenance Plans and Costs	63
Construction Plans and Costs	67
SEAPORTS	67
Facilities, Age, and Condition	70
Maintenance Plans and Costs	71
Construction Plans and Costs	72
HIGHWAYS	74
Facilities and Age	75
Maintenance Plans and Costs	80
Construction Plans and Costs	81
TUNNELS	81
SUMMARY	82
Part 4, ENVIRONMENTAL INFRASTRUCTURE--WATER	84
WATER	84
Water Supply	90
Existing Facilities and Age	92
Current Conditions	95
Needs	98
Plans	99

Title	Page
Water Distribution	101
Existing Facilities and Age	102
Current Conditions	103
Maintenance Plans	107
Maintenance Costs	109
Construction Plans	115
SUMMARY	116
Part 5, ENVIRONMENTAL INFRASTRUCTURE--SEWERAGE SYSTEM	118
SEWAGE TREATMENT	119
Existing Facilities and Age	120
Current Conditions	120
Maintenance Costs	123
Construction Costs	123
Construction Needs	123
Construction Plans	130
SEWAGE COLLECTION SYSTEM	130
Existing Facilities and Age	130
Needs	134
Construction Plans	134
HAZARDOUS WASTE	135
Existing Facilities	136
Needs	137
Costs	137
SUMMARY	137
Part 6, SUMMARY OF NEEDS AND REVENUES: MASSACHUSETTS	140
NEEDS	140
REVENUES	145

Title	Page
APPENDIX A, MASSACHUSETTS REGIONAL TRANSIT AUTHORITIES	149
APPENDIX B, RTA FACILITY SURVEY	150
APPENDIX C, MASSACHUSETTS INFRASTRUCTURE STUDY, 1983: QUALITY OF INFORMATION AVAILABLE	151
APPENDIX D, REGIONAL PLANNING DISTRICTS	154
APPENDIX E, INTERVIEW GUIDELINES	155
LIST OF REFERENCES	163

LIST OF FIGURES

Figure No.	Title	Page
1-1	Capital Expenditures in Massachusetts by Type, FY1968-69 through FY1981-82	4
1-2	Revenues in Massachusetts for Capital Expenditures for Highways and Sewers, FY1973-74 through FY1982-83	5
3-1	1982 Commuter Rail Network	39
3-2	Number of State-Owned Bridges Built Per Year	53
3-3	Number of City/Town-Owned Bridges Built Per Year	54
3-4	AASHTO Sufficiency Ratings <80	57
3-5	AASHTO Sufficiency Ratings <50	58
3-6	Airport Coverage in Massachusetts	61
3-7	Massachusetts Essential Airport System	62
4-1	Source of Water Supply for Massachusetts Communities, 1982	93
4-2	Projected 1990 Water Supply Status for Massachusetts Communities, Preliminary Assessment	96
4-3	Communities Applying for 406 and 805 Local Assistance Grant Programs	110
Exhibit 5-1	Prioritized List of Projects	125

LIST OF TABLES

Table No.	Title	Page
3-1	Book Value of Selected MBTA Transportation Equipment/Facilities, 1982	21
3-2	Listing of MBTA Federal Funding to 1983	23
3-3	Transit Capital Funding Schedule FY1981-1987	24
3-4	Major Mass Transit/Bus Service Maintenance and Repair Projects as of 1983	26
3-5	MBTA Bus Garage/Storage Facility (1982)	28
3-6	Value of Rapid Transit/Green Line Stations	30
3-7	MBTA Rapid Transit/Green Line Vehicle and Track Statistics, 1983	32
3-8	Rapid Transit Rail Equipment/Green Line Requested Maintenance 1983/FY1984	33
3-9	The Green Line, 1982	36
3-10	Commuter Rail Inventory, 1981	40
3-11	Commuter Rail Rolling Stock, 1981	41
3-12	1983 MBTA Commuter Rail Operated Rail Lines	42
3-13	Commuter Rail Improvement Program (CRIP)	44
3-14	5-Year Commuter Rail Improvements Summary of Costs, 1983-1987	46
3-15	Railroad/Highway Grade Crossing Projects 1982 and Proposed 1983 Costs	48
3-16	RTA Fixed-Route Service, FY1982	50
3-17	Highway Bridges--Existing Facilities	52
3-18	AASHTO Rating of Massachusetts Bridges	56
3-19	Airport and Runway Description	64
3-20	Airport Construction Plans and Costs, FY83	68

Table No.	Title	Page
3-21	Existing System Mileage by Functional Classification	76
3-22	Existing Mileage by Funding System	76
3-23	Funding Systems	77
3-24	Jurisdictional Comparison	78
3-25	Road Miles and Daily Vehicle Miles Traveled	78
3-26	Summary of Capital Investment Needs and Revenues in Massachusetts--Transportation	83
4-1	Population and Water Supply for Communities of 10,000 or More, 1982	85
4-2	Recent Population Trends in Six Water-Supply Systems	91
4-3	Number of Miles of Water Mains in Selected Towns, Age of Oldest Mains, and Percentage of System Metered, 1979	104
4-4	Water Distribution in the Old Colony Planning Council Region	106
4-5	Summary of Leak Detection Grants Awarded through 1983	111
4-6	Estimated Cost of Rehabilitation and Replacement, and Method of Water Department Financing, 1979	112
4-7	Summary of System Rehabilitation Grants Awarded through 1983	113
4-8	Summary of Capital Investment Needs and Revenues in Massachusetts--Water Supply	117
5-1	SRPEDD District Sewage Treatment Facilities	121
5-2	1982 EPA Assessment of Backlog Costs	129
5-3	1982 Estimates of Year 2000 Needs	131
5-4	Sewage Systems in Selected Cities and Towns	133
5-5	Summary of Capital Investment Needs and Revenues in Massachusetts--Wastewater	138
6-1	Summary of Capital Investment Needs and Revenues in Massachusetts	141

31-895 O - 84 - 2

LIST OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
B&M	Boston and Maine
CTPC	Central Transportation Planning Commission
DEM	Department of Environmental Management
DEQE	Department of Environmental Quality Engineering
EDA	[U.S.] Economic Development Administration
EMMA	Eastern Massachusetts Metropolitan Area
EOEA	Executive Office of Environmental Affairs
EOTC	Executive Office of Transportation and Construction
EPA	[U.S.] Environmental Protection Agency
FHWA	Federal Highway Administration
FY	Fiscal Year
GAO	[U.S.] Government Accounting Office
LRV	Light Rail Vehicle
MAC	Massachusetts Aeronautics Commission
MBTA	Massachusetts Bay Transportation Authority
MDPW	Massachusetts Department of Public Works
MDC	Metropolitan District Commission
MTA	Metropolitan Transportation Authority
mgd	million gallons per day
NMRPC	Northern Middlesex Regional Planning Commission
OCPC	Old Colony Planning Council
PCC	Presidential Conference Car
RDC	Rail Diesel Car
RPA	Regional Planning Agency
RTA	Regional Transit Authority
SRPEDD	Southeastern Regional Planning and Economic Development
TOTOA	Toronto Area Transportation Operating Authority
TRIP	The Road Information Program
UMTA	[U.S.] Urban Mass Transportation Administration

ACKNOWLEDGMENTS

This project could not have succeeded without the direct and indirect help of many people. The research staff particularly thanks Mr. Alden Raine, Director of the Governor's Office of Economic Development. His office provided some of the financial support for the project and helped locate key personnel within each agency from whom staff members could obtain the information presented in the report. Louis S. Moore from that office was the liaison with the research staff. An initial meeting held in Mr. Raine's office on February 10, 1983, helped to establish the setting within which the research could be conducted as quickly as possible. As a result of that meeting, staff members met with James P. Atkinson, Special Assistant to the Secretary of the Executive Office of Transportation and Construction, and with Elizabeth Kline, special assistant to the Secretary of the Executive Office of Environmental Affairs, both of whom were key people in helping to locate the information and in identifying state personnel with whom the research staff could meet. In addition, both Mr. Atkinson and Ms. Kline read drafts of this report and provided many valuable comments on it.

Staff members met with a large number of people in the state and also communicated with many other people in the state and in Washington, DC, by phone. The list is long. Some spent only a small amount of time, while others devoted several days in helping. To each, we express our deep appreciation. They include:

Budget Bureau
Mary Shaughnessy, Assistant Budget Director
Alexandra Schweitzer, Budget Analyst

Central Transportation Planning Staff
Toby Pearlstein, Librarian

Department of Environmental Management
Diane Hoffman, Project Manager for Policy Development, Bureau of Solid Waste Disposal

Department of Environmental Quality Engineering
George Howland, Division of Water Supply
Paul Taurasi, Chief Engineer, Construction Grants Program, Division of Water Pollution
Hank Southworth, Acting Section Chief, Policy and Program Management, Division of Hazardous Waste

Executive Office of Environmental Affairs
Richard Thibedeau, Chief Planner, Division of Water Resources Planning

Executive Office of Transportation and Construction
Paul McBride, Assistant Secretary for Rail Operations
Howard Taub, Planner

Massachusetts Aeronautics Commission
Richard Kimball, Airport Engineer
David Graham, Chief Aeronautical Inspector

Massachusetts Bay Transportation Authority
Francis X. Crowley, Chief Rail Maintenance Officer
Ralph Duvall, Chief Engineer, Engineering Maintenance
Robert Gerry, Assistant Chief, Automotive Equipment Officer
Lawrence Gleason, Department Supervisor of Everett Shops
Thomas Kennedy, Capital Funding Management
William MacDonald, Assistant Director & Chief Engineering Officer for Railroad Operations
Robert Pittman, Supervisor

Massachusetts Department of Public Works
Francis Bratton, Assistant Maintenance Structural Engineer
Norman Diegoli, Deputy Chief Engineer for Highway Maintenance
Phillip Hughes, Assistant Supervisor for Highway Data and Statistics
Richard H. McGinn, Maintenance Structural Engineer
Thomas Richardson, Central Environmental Planning Office Administrator

Massachusetts Port Authority
Anne Aylward, Acting Port Director
Joseph Brevard, Chief Planner

Massachusetts Senate
Carol Amick, State Senator
Steven Karnas, Committee on Ways and Means

Massachusetts Turnpike Authority
John Dias, Maintenance Engineer
Edward King, Director of Community Relations

Metropolitan District Commission
Julia O'Brien, Planning Director

Office of Senator Paul Tsongas
Steven Johnson, Economic Development Assistant

The Road Information Program, Washington, DC
Sally Thompson, Research Director

Wallace, Floyd Associates
Wendy Landman, Senior Planner

Although staff members from the different regional planning commissions are not listed separately here, we are grateful for the extensive efforts some of them made to help us obtain information on local infrastructure.

We are also appreciative of the financial and other support supplied by the Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University, and the Department of Urban Studies and Planning of the Massachusetts Institute of Technology. Bernard J. Frieden and Gary A. Hack from the Department were instrumental in setting up the initial contact between Karen R. Polenske and Richard D. Tabors from the Massachusetts Institute of Technology, and Marshall Kaplan, from the University of Colorado, who is coordinator for these infrastructure projects being undertaken throughout the United States.

Finally, several of our colleagues from the Department of Civil Engineering at the Massachusetts Institute of Technology were especially helpful during this project. Both Thomas F. Humphrey and Michael J. Markow provided staff members with transportation literature from their personal files, met several times with us

to discuss specific issues and types of information, and read and commented on drafts of this report. Nigel H.M. Wilson provided useful information on the Massachusetts Bay Transportation Authority. Daniel Mesnick, a graduate student in the Department of Urban Studies and Planning, assisted in obtaining revenue and expenditures data.

We appreciate the care with which people read different verisons of this report; the authors, of course, assume full responsibility for the information reported.

AN ASSESSMENT OF PUBLIC INFRASTRUCTURE IN MASSACHUSETTS

The purpose of this report is to present a preliminary assessment of public infrastructure in Massachusetts. During the study, major emphasis was given to the identification and evaluation of current (1983) public infrastructure for transportation, water, sewers, and hazardous waste. In addition, an initial estimate was made of public infrastructure needs and anticipated revenues (where possible to the year 2000). This is one of a series of studies being conducted in over 20 states for the Joint Economic Committee of the U.S. Congress. Stress must be placed on the preliminary nature of the findings.

The first part of the report contains a summary of the major conclusions. In the second part of the report, an explanation is given of the methods used to obtain the information, and a brief introduction is provided to the economic, political, and social factors in Massachusetts relevant to an assessment of infrastructure in the state. The various types of transportation infrastructure and environmental infrastructure are assessed in the third and fourth parts of the report, respectively. The fifth part of the report contains a brief discussion of public infrastructure needs, and the final part contains some general policy recommendations for the state.

Part 1

EXECUTIVE SUMMARY FOR MASSACHUSETTS

General Conclusions

Most maintenance expenditures are being deferred, forcing a crisis response rather than planned maintenance.

The completion date of a fair number of projects is being delayed or the project is not being completed because of lack of funds.

Capital expenditures for current needs are insufficient.

Few consistent data exist across administrative divisions with which to evaluate the overall state of infrastructure needs. Such data can be, and some were, obtained from the 14 Regional Transportation Authorities, but comparable infrastructure data were not obtained from most of the 13 Regional Planning Agencies.

Specific Conclusions

Bridges and tunnels (roads and rail) require immediate attention as deferred maintenance has created a potential for catastrophic failure.

Within the MBTA, the system age and deferred maintenance with limited funds for system rejuvenation are causing lowered reliability and, apparently, higher average operating costs.

There are no serious problems with airports.

Current planning for harbor development appears adequate.

In the area of potable water supply, the state has initiated its own program to repair the distribution system. However, insufficient information is available to define and assess the full magnitude of the problem. It appears that available funds do not meet needs.

While considerable planning and publicity have occurred, no sol tion to in-state handling of hazardous waste has been found.

Meeting the federal requirements for sewage treatment and disposal will require a massive investment in treatment and facilities over the next decade. Lack of improvements to sewage treatment are perceived by many to be the major impediment to the cleanup of Boston Harbor.

The quality of (and therefore the need for) roads within the state is dependent upon the administrative jurisdictions under whose authority they fall and often on the wealth of the community in which they exist.

To provide an overview of past trends, annual data were assembled on expenditures and revenues on transportation and environmental infrastructure. All data were converted to constant 1982 dollars. The annual data are shown graphically in Figures 1-1 and 1-2.

As shown in Figure 1-1, expenditures on water-supply infrastructure have increased gradually from a low of $38 million in FY 1968-69 to $64 million in FY 1981-82. A surge in expenditures in FY 1974-75 to $169 million was a one-year phenomenon that did not recur in later years. Expenditures on sewerage infrastructure also increased from $80 million in FY 1968-69 to $153 million in FY 1981-82, with a year of peak expenditures of $160 million occurring in FY 1972-73 and another of $251 million occurring in FY 1979-80. These increases in environmental infrastructure expenditures were more than offset by the decreases in highway expenditures, from a total of $500 million in FY 1968-69 to a total of only $299 million in FY 1981-82.

As shown in Figure 1-2, revenues in Massachusetts both for highways and sewerage have declined significantly since the early 1970s. Revenues for sewerage fell from a high of $310 million in 1973-74 to a low of $69 million in 1982-83, while those for highways fell from $283 million in 1974-75 to a low of $126 million in 1982-83.

Emphasis should be given to the fact that the annual expenditures and revenues portrayed in Figures 1-1 and 1-2 represent only a portion of the total infrastructure expenditures and revenues during this time period. Annual data for other infrastructure categories were not readily available. A few of the critical factors that have affected the individual infrastructure expenditures and revenues are indicated throughout the remainder of this report.

Figure 1-1. Capital Expenditures in Massachusetts by Type, FY1968-69 through FY1981-82

SOURCE: Expenditures Data: U.S. Bureau of the Census. Governmental Finances. Washington, DC: Government Printing Office, various years.
Deflators: U.S. Department of Commerce, Bureau of Economic Analysis "BEA Deflators," unpublished worksheets.

Figure 1-2. Revenues in Massachusetts for Capital Expenditures for Highway and Sewers, FY1973-74 through FY1982-83.

SOURCE: Data received directly from the Federal Highway Administration and the Sewer and Water Monitoring Division, Environmental Protection Agency.

Part 2

BACKGROUND TO THE ANALYSIS

This preliminary analysis of the public infrastructure in the state of Massachusetts was undertaken to provide a basis for a more comprehensive analysis in the future. One of the principal goals of the analysis was to determine the major issues related to each type of infrastructure and the most important data gaps. Before presenting the analysis, the methods used to obtain the information are outlined.

METHODS OF ANALYSIS

Most of the public infrastructure information presented in this report was obtained from publications provided by the relevant state agencies and through personal interviews. In addition, a concerted effort was made to obtain details, especially on local public infrastructure, from the regional transit authorities and regional planning agencies. Unless otherwise noted, all dollar figures are presented in constant 1982 dollars.

A few general factors affected all of the research efforts. In January 1983, when the present study was initiated, a new gubernatorial administraton had just taken office. It therefore took the research team extra time to collect some of the information than it would have taken if a change in administration had not occurred and meant that fewer data could be collected than originally anticipated. In addition, information on past and planned infrastructure has not been assembled in one report by any agency; even the collection of information on current infrastructure in place therefore had to be incomplete.

State Agencies

The study of public transportation infrastructure was begun with a search at the Central Transportation Planning Staff library. The library was a source of historical and background information; however, there was very little current information. The Executive Office of Transportation and Construction provided literature on public transportation facilities. The rapidly changing situation with respect to inventory, particularly rolling stock, rendered much of the documentation in this literature out-of-date.

In attempting to collect information on the various transportation modes under the Massachusetts Bay Transportation Authority (MBTA), it became evident that political and economic factors affecting the MBTA, and its predecessor the Metropolitan Transit Authority (MTA), created problems in obtaining reliable and up-to-date data. The staff at the MBTA did actively participate in locating and providing the information used in this report. The data, however, were organized in a cumbersome and inadequate way for an overall assessment of the mass transportation infrastructure.

The MBTA library, to which the research staff was given access, was of marginal utility, primarily because the studies conducted, which are numerous, are of a narrowly focussed technical orientation, with little reference to the whole of any single transit operation. The MBTA currently lacks a short-term or long-term assessment of overall transit coordination and planning. Within the last decade, rapidly increasing oil prices, general inflation, and the current recession have transferred attention away from automobile and highway transportation toward fixed-route mass transportation. More attention, therefore, will start to be given in Massachusetts to long-term mass transportation planning.

The MBTA also appears to be a highly fragmented operation, not only

with respect to its many areas of responsibility, including three separate rapid transit lines, a light rail vehicle operation, an extensive bus and commuter rail system, and a distinctive trackless trolley, but also with respect to the areas of maintenance, storage, and other auxiliary (for example, power and power generation) facilities. As a practical matter, it was difficult to find any written or personal source of expertise on the infrastructure in existence and needed for the overall MBTA operation, which means that a great deal of effort and time was expended in piecing the structure together from scattered sources of information.

A large portion of the most important data was taken not from published accounts or interviews, but from summary sheets that were usually not in a form easily available for public access. Hence, hastily assembled summary sheets and reports tend to substitute for public transportation studies or detailed annual reports. An MBTA "Management Report" for the new Dukakis administration in January 1983 is the closest facsimile to a general overview of the transportation system, but even this report provides little descriptive indication of what overall standards the MBTA envisions as part of an efficient mass transit system. The data gathered on the MBTA, then, was obtained primarily from recently (1982,1983) published reports and unpublished current summary sheets, which, though limited, appear to be generally reliable.

For the Regional Transit Authorities (RTAs), the data were collected from a published 1981-1982 "Operations Report," and from a questionnaire mailed to all 14 RTAs by the Executive Office of Transportation and Construction (EOTC) planning section. (The questionnaire is included as Appendix A, and a map of the 14 RTAs is included as Appendix B.) The data focus on future fixed-route bus service requirements. While the cost

projections cannot be precise, different inflation estimates employed allow for a range of possibilities.

Data on state-owned railroad grades and crossings, bridges, and tunnels were based upon information stored in the Massachusetts Department of Public Works computer files.

Documented information on the current condition of the road system in the state, especially local roads, was particularly difficult to locate, as were plans for maintenance and construction. The Massachusetts Department of Public Works (MDPW), was the major source of state highway and bridge information. Most of the data were obtained through interviews, but a good deal of that information is very tentative in nature. The tentative nature of the information was reinforced by uncertainty at the MDPW regarding the funding priorities and levels of Congressional appropriations. The difficulties in collecting data were also a function of the significant recent reductions in the MDPW staff. As a result, much of the information that should have been available from the MDPW was incomplete or unavailable because of an excessive backlog due to severe staff shortages. In spite of the political and technical constraints they were operating under, the MDPW staff were extremely helpful in providing the information on the state highway and bridges used in this report.

As already indicated, data for the local road system was extremely difficult, and, in some cases, impossible to collect because of the lack of a centralized source of information. The Regional Planning Agencies were not equipped or structured to overcome this problem. In some cases, the agencies lacked even a process by which the type of information needed could be collected. The most comprehensive source of local road information was the Road Information Program in Washington D.C. Attempts to collect sufficient

and accurate data on the state's local road system would require more time and staff than allotted for this study.

Collection of data on the state's seaport facilities was also hampered by the lack of a centralized source of information. The staff at Massport were able to provide some data on the New Bedford and Fall River ports, however, as would be expected, most of the information provided was on the Port of Boston. Again, because of the decentralized nature of the data, additional time and staff would be required to collect comprehensive and reliable information on the state's seaport facilities.

In contrast to the other transportation modes, information on the state's airports is collected at a centralized location, the Massachusetts Aeronautics Commission. The data immediately available at the Commission were not comprehensive, but appeared to be reliable. There is every reason to believe that in the future the Commission could be extremely useful in providing additional help.

All of the information in this report on the Callahan and Sumner Tunnels was obtained through telephone interviews with officials at Massachusetts Turnpike Authority, under whose jurisdictions the Tunnels lie. Efforts to collect more information on the state's tunnels will require greater cooperation between the responsible state bodies and the research team than occurred for the current project.

Altogether, the data collected on the public transportation sector must be considered preliminary. Time factors, including limited preparation time, made it impossible to examine the interface of public demands on mass transit and political, economic, technical, and labor aspects of the question. Perhaps the most striking planning consideration is the absence of literature on the MBTA that would provide a comprehensive understanding of the system,

including its facilities and operations.

The study of environmental infrastructure was begun by obtaining information from the Office of the Secretary of Environmental Affairs. Staff in the Executive Office of Environmental Affairs (EOEA) provided available literature and material from files and suggested that project staff speak to personnel in several departments within EOEA.

The kind of information obtained dealt largely with statewide programs that are already in place, such as for the Chapter 286 leak detection and system rehabilitation grant program, and the various sewerage treatment facilities built to help communities comply with federal environmental legislation. But systems that are financed and administered on the local level remain largely unstudied.

Because the state commissioned a water-supply policy study during the late 1970s, a direct result of a series of dry years, there was good information on issues of water supply. In addition, the Division of Water Resources Planning had just completed a survey of the state's communities. Although municipalities had been asked to provide information on their water supplies in millions of gallons of water per day, they had not been asked any questions on the water-distribution systems. This was a lost opportunity to gather important information. Other ways were attempted to discover the number of miles, and the condition, of water pipes in the distribution systems of communities across the state. As background for Chapter 805 legislation passed in 1979, EOEA had surveyed a nonscientific sample of communities, but received only fifteen responses. These data are reported, but similar data from all communities in the state would go a long way toward estimating the water-distribtion infrastructure needs of the state.

In supplying figures on the number of miles and the condition of water

and sewer pipes in the Commonwealth, the staff at the Department of Environmental Quality Engineering (DEQE) tried to be of assistance. However, they do not have those data. A staff member in the Division of Water Supply thought that information on sewage pipelines existed in the four regional offices of DEQE. Because it was not possible to ascertain whether that information existed in all of the offices, a site visit to each office to obtain data was never arranged.

In short, the types of infrastructure financed, administered, or monitored by the state, such as water supply and sewage treatment, were relatively well-documented, but those of concern to localities remain unstudied. At the state level, only problems that provided high levels of funding and that received significant media attention have been studied by others. Basic data collection needs have been largely ignored, with the consequence that there is no assessment of the magnitude of the water and sewerage infrastructure problem at the local level. The Chief Engineer.of the Construction Grants Program in the Division of Water Pollution Control, DEQE, for example, assured the staff that there was absolutely no way to discover the miles or conditions of sewage pipes in the state without a major study by a consulting engineer. The basic issue of the extent and condition of the infrastructure that delivers water to, and removes sewage from, homes and businesses is completely unaddressed by any data collection undertaken so far by the Commonwealth.

The major difference between hazardous waste on the one hand, and water and sewerage infrastructure on the other, is that hazardous waste facilities are privately owned and operated, whereas water and sewerage infrastructure is within the public sector. Because DEQE is a regulator, not a provider, the only information available was that related to the existence

of hazardous waste-treatment facilities. In addition, a copy of an environmental impact study on hazardous waste, which was completed in August 1982, was obtained.

In Appendix C, the research staff have presented a summary of their judgments concerning the quality of the information available for use in preparing this report. The assessments were based upon two factors: (1) the amount of information available, and (2) the presumed reliability of the information. The assignments of excellent, good, fair, and poor were necessarily made using judgmental assessments of the research staff, rather than statistical analyses. Although the staff attempted to classify the information into four categories, none of the information was considered to be of excellent quality; therefore, only three of the four categories appear in the table.

Because information available from the state agencies frequently did not include local infrastructure data on roads, sewer, water, etc., the research team also attempted to obtain these local data from the regional planning agencies, which are discussed in the next section.

Regional Planning Agencies

There are 13 Regional Planning Agencies (RPAs) in the Commonwealth of Massachusetts, which were set up during the 1970s to coordinate regional planning efforts in the state. The RPAs are shown on the map in Appendix D.

The staff members assumed that since most of the information not obtainable from the state agencies pertained to locally funded and administered programs, the RPAs, which have a local orientation, should be able to fill in the missing pieces. A questionnaire (Appendix E) was therefore designed and mailed to each of the 13 RPAs. Each agency was then

called to see whether the questionnaire had been received and to determine whether or not there were any questions concerning it. It was discovered that the regions varied greatly in their capacity to provide the data requested.

Both the Franklin County Department of Planning and the Berkshire County Regional Planning Commission sent letters explaining that the data requested were beyond their capacity to provide. The Planning Director in Franklin County estimated that providing the requested information "would be a nice project for a summer intern or a cost equal to that." The Director of the Berkshire County Regional Planning Commission estimated that potential costs to gather the information for Berkshire County ranged from $7,500 for in-house data compilation, a procedure that could meet an estimated 15 percent of the data needs, to $90,000 to gather 90 percent of the data, and $180,000 to $200,000 to provide 100 pecent of the information requested from Berkshire County.

The Metropolitan Area Planning Council (MAPC), the RPA for the Boston area, also estimated the cost of data compilation. The Director of Land Use and Environmental Quality outlined the kinds of data sources that could be exploited to meet the data requested for the MAPC and provided the following time and cost estimates: for water supply and distribution data, approximately four weeks of staff time, or about $4,000; for sewage collection and treatment, another 4 weeks, or $4,000; for solid waste facilities, between 4 and 12 weeks, depending upon the level of detail required; and for hazardous waste facilities, about 7 weeks of staff time. With respect to the transportation infrastructure (highways, bridges, tunnels, railroad crossings and lines), it was estimated that collecting information on just the condition of local roads in the MAPC region would take a minimum of six months to a year; for airports, about 4 weeks would be needed to identify and compile

information on Logan Airport and other airfields in the MAPC region; and about 4 weeks to identify and compile information on mass transit in the Metropolitan Boston area.

Four of the RPAs provided data that could be incorporated into this study. The Lower Pioneer Valley Regional Planning Commission organized a three-week data-collection effort, which provided good information on transit and local roadways, but they could not find any data on either water or sewerage infrastructure. The Old Colony Planning Council provided reports and separate sheets of data from which a considerable amount of information was obtained for use in this report. The Southeastern Regional Planning and Economic Development District (SRPEDD) also sent reports, with some updated materials attached, and much of that information was also used. Just before this report was completed in May 1983, the Northern Middlesex Area Commission sent materials that covered each of the infrastructure areas rather comprehensively. This material was also incorporated into the final version of this report. The SRPEDD and the Northern Middlesex Area Commission were the only RPAs that filled out the questionnaire and provided some information on each community in their region.

Although the questionnaire was mailed to all 13 RPAs, and at least two follow-up telephone calls were made to each one that had not responded, no material was received from 6 of the 13 RPAs.

CONTEXT FOR THE STUDY

As one of the first parts of the country settled by English immigrants, one of the original thirteen American colonies, and one of the oldest industrial states in the country, many of Massachusetts' infrastructure problems are a direct corollary of the antiquated infrastructure in the

Commonwealth. The age of the infrastructure is important especially when comparing Massachusetts with more newly settled areas of the country. An old state, Massachusetts was one of the first to encounter both the problems of growth (in the nineteenth century) and the problems of decline (in the twentieth century).

Massachusetts has been a leader in the public provision of infrastructure for many years. For example, Boston was the first city in the country to build a subway system. Some of the problems of that transit system today stem from its status as a model that other cities have copied. Other cities learned from the mistakes made in Boston and had years to implement the lessons. Route 128 was built as a circumferential road around the Boston metropolitan area just after World War II; this highway provided other states with an example of what to do, and what not to do, when designing a limited-access highway. That highway was key to the development of suburbs around Boston, as well as to the success of the high-tech industry.

Today, Massachusetts again finds itself in a pioneering role, providing a system of grants for leak detection and system rehabilitation of water-distribution systems across the state, in advance of any federal legislation that would accomplish those goals. Partly because the water-distribution systems of the cities and towns are so old, some dating to the middle of the nineteenth century, and partly because of some farsighted planning during the 1970s, the need to begin to repair these systems was seen and implemented four years ago.

But Massachusetts shares problems with other states, such as the lack of a good inventory of existing infrastructure at the local level; the deferred maintenance of infrastructure facilities; a decline in federal contributions for infrastructure state projects; and a decrease in state

revenues due to the recession and other factors. In the latter case, for example, Massachusetts' voters have imposed a local tax-limitation measure, referred to as Proposition 2-1/2, that has reduced the revenues available to municipalities across the state to fund both current and capital outlays.

Economic Factors

The employment structure of Massachusetts has undergone a long-term shift away from manufacturing and toward services and computer-related industries, known colloquially as "high-tech." These service and high-tech industries are characterized by widespread dispersal, rather than concentration inside of cities or even SMSA's. The growth of these scattered industries was helped substantially by previous infrastructure decisions, such as the construction of Route 128 around the perimeter of Boston and the subsequent location of computer industries along that route. Future economic growth could well be enhanced by wise investment in infrastructure, and lack of, or unwise, investment could inhibit economic growth in the long run.

Population Trends

Although the Commonwealth of Massachusetts has a growth policy that tries to channel population growth into existing communities rather than encouraging scattered housing in fringe areas, long-term population trends run counter to this policy. The economic transition to service and high-tech industries has been accompanied by dispersal of the labor force of those industries. Along with many firms located in fringe areas, population has been moving toward the least dense areas of Massachusetts. Between 1970 and 1980, the population of central cities in the state declined by 5.2 percent, the urban fringe grew by 7.7 percent, and rural areas grew by 5.7 percent, while the population of the state as a whole was growing by just 0.8 percent

(U.S. Bureau of the Census, 1980, part B). Demographers at the Joint Center for Urban Studies (Masnick and Pitkin, 1982) predict, for Massachusetts, that in the long run metropolitan growth will continue to decrease, and nonmetropolitan growth will increase.

According to Tabors (1979),

> no calculaton is more important in the sizing of [water, sewerage, or solid waste disposal systems] than the projection of future . . . population. Population size frequently depends on infrastructure development as much as the size of infrastucture investment depends on the size of the population (p. 186).

Therefore, predictions of continued nonmetropolitan growth imply that although the total population of the state is virtually unchanged, the shift in growth from the cities to the fringe areas means that there will be continued demand for publicly provided infrastructure in fringe areas.

The next two parts of this report contain assessments of the current transportation and environmental infrastructure and future needs for the state of Massachusetts.

Part 3

TRANSPORTATION INFRASTRUCTURE

Information on public transportation infrastructure was obtained for the following components: Massachusetts Bay Transportation Authority, state-owned railroad grades and crossings, state-owned railroad bridges and tunnels, Regional Transit Authorities, highway bridges, airports, seaports, highways, and highway tunnels. Each of these will be discussed in this part of the report.[1]

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

The mass transit system of the metropolitan Boston area, the oldest and currently the fifth largest in the nation, today serves 79 cities and towns in eastern Massachusetts and some 168 million passengers yearly. First operated as an horsecar line in 1856 between Cambridge and Boston, public rail transport spread rapidly, with bankers and speculators extending lines throughout the expanding urban-suburban metropolis. In 1897, Boston became the first U.S. city with a subway. By 1904, Boston had the first underwater tunnel, located beneath the Boston Harbor. The 1920s and 1930s brought motor bus and trackless trolleys to the city area.

By this time, however, public transit was already facing the development and rapid expansion of private automobile transportation that competed for public financing and ridership. Severe problems with the Boston

---

[1] It should be pointed out that there are essentially three types of budgetary years used in this report: the federal fiscal year (October 1-September 30), the calendar year (January 1-December 31) and the state fiscal year (July 1-June 30). The state fiscal year was begun for 1983-1984 (FY1984). In some places the use of 1983/FY1984 appears, which refers to the overlapping period covered by the transition from the calendar to the fiscal year, which is 18 months, in the Commonwealth. Most capital projects, however, are administered on the basis of the federal fiscal budget, October 1 through September 30.

Elevated led to the Public Control Act of 1918 and continuing instability to the creation of a regional transit agency representing 14 cities and towns, the Metropolitan Transit Authority (MTA) in 1947. Although the MTA continued to grow, it also continued to have financial difficulties. The transit system was reorganized under the name of Massachusetts Bay Transportation Authority (MBTA) in 1964 and was expanded to include 78 cities and towns (later 79) under its jurisdiction. Economic downturns, inflation, oil price increases, air pollution, and other issues in the 1970s combined to give new life to mass transit and to bring increases in ridership, up to 300,000 daily by the end of the decade (MBTA, 1982a, pp. 1-6).

At present, the MBTA consists of three rapid transit lines, in addition to the light rail vehicle (LRV) "Green Line," commuter light rail, bus services, and trackless trolleys. As part of its public transportation responsibilities, the MBTA maintains in operating condition almost 2000 vehicles--1049 buses, 353 rapid transit cars, 74 streetcars/125 light rail vehicles, 50 trackless trolleys and 126 commuter rail vehicles (MBTA, 1983c, p. 1). The value of major MBTA equipment and facilities is indicated in Table 3-1.

One of the obstacles in assessing needs projections for the MBTA system as a whole is the fact that attention and financial assistance to the maintenance of the current systems' operations occur on a largely ad hoc crisis-by-crisis basis, with too little focus on establishing preventive maintenance/replacement priorities on a long-term basis. This can be explained, in part, by the complexity of maintaining an old transit system that is forced to run on several generations of parts and equipment. The problem also reflects, in part, the shifting priorities of the federal government toward mass transit over the years. Currently, the federal

Table 3-1

BOOK VALUE OF SELECTED MBTA TRANSPORTATION EQUIPMENT/FACILITIES, 1982

	Book Value	Annual Rate of Depreciation
Way and Structure		
Tunnels and Subways	$ 45,004,415	2.0000
Bridges, Trestles and Culverts	27,122,322	1.3333
Trackwork	133,004,073	n.a.
Elevated Structures and Foundations	9,520,984	1.3333
Signals and Interlockers	32,896,147	1.9000
Communications Systems	27,755,594	1.9000
Distribution System	25,192,903	2.2222
Shops, Carhouses, and Garages	75,464,483	1.6667
Shops, Carhouses, and Garages	1,461,512	3.3333
Stations, Misc. Bldgs., and Structures	112,908,431	1.6667
Equipment		
PCC Cars	3,177,301	4.0000
Buses	67,569,274	8.3333
Trackless Trolleys	3,962,504	6.6667
Quincy Line Cars Silver Birds	17,251,181	4.0000
Orange Line Cars Main Line	5,145,760	15.2317
Blue Line Cars (Old)	1,894,471	2.2222
Cambridge Dorchester Lines	16,009,232	4.0000
B&M Cars RDCs	2,951,000	10.0000
LRVs	38,647,511	5.0000
Commuter Rail Coaches	30,099,433	4.0000
Orange Line (New) 1979	70,607,527	4.0000
Blue Line (New) 1979	37,772,334	4.0000
Power		
Power Plant Structures	11,263,853	1.6667
Power Plant Equipment	28,270,188	2.8571
Transmission	2,097,035	2.0000
Other		
Total Subway and Tunnels and Facilities Constructed by MBTA 8/2/49-8/3/63	32,783,085	--
Original Cost of Subway and Tunnels 8/3/49	70,346,941	--
Total Property	$1,207,986,314	--

SOURCE: MBTA, Depreciation Schedule, 6/30/81 to 6/30/82.

government constitutes the primary source of revenues on most major MBTA projects. Of $2.8 billion currently invested in federally supported mass-transit projects, the federal government provides $2.2 billion (about 80 percent) of the funding. Past and current projects are shown in Table 3-2, which includes projects funded since the 1960s. Projected sources of future funding of mass transit can be seen in Table 3-3. Another factor that mediates against long-term transit planning is that within the Commonwealth, new state administrations, in general, have tended to slow or accelerate the established capital-improvement programs, rather than undertake a complete revamping.

Discussion of public transportation will focus on the MBTA bus, rapid transit, Green Line, trackless trolley, and commuter-rail services, followed by a brief consideration of the Commonwealth's Regional Transit Authorities (RTAs), and the state railroad grades, crossings, bridges, and tunnels. The sources of information are referenced throughout the text. As mentioned in Part 2, the Executive Office of Transportation and Construction (EOTC) distributed a questionnaire to the 14 RTAs.

Bus System

Of the MBTA transit services, buses have the smallest fixed-facility requirement, but because buses use infrastructure (for example, highways) shared by private vehicles, evaluation of its relative efficiency and cost would, therefore, need to consider complementary investments made in non-public transportation sectors.

Facilities, Age, and Current Condition

As of May 1, 1982, there were 1220 vehicles in the MBTA area, of which 1049 were available for daily operation, 724 were assigned to specific routes

Table 3-2
LISTING OF MBTA FEDERAL FUNDING TO 1983

Number	Project Name	Project Cost	Federal Share
03-0001	Station Modernization	$ 9,115,920	$ 5,917,924
03-0002	Purchase 150 Buses	4,204,681	3,136,654
03-0003	Haymarket Tunnel	18,000,000	11,997,599
03-0004	South Shore RT Extension	57,999,295	36,081,916
03-0005	Haymarket North Extension	100,880,471	67,506,654
03-0007	Cabot Transportation Center	36,150,235	25,096,[illegible]
03-0010	Systemwide Modernization	4,702,725	3,162,204
03-0011	Purchase 310 Buses	12,150,375	8,100,250
03-0013	Station Modernization - Phase II	14,517,035	9,731,[illegible]
03-0015	Green Line Improvements	91,075,143	60,283,527
03-0016	Charlestown Bus Garage - Phases I, II	37,077,980	25,[illegible],354
03-0017	Plant Improvements - Phase I	9,513,555	6,29[illegible],21[illegible]
03-0018	Purchase 125 Buses	6,931,835	5,545,468
03-0019	Power Improvements - Phase I - V	86,604,605	69,093,684
03-0021	Non-Revenue Equipment	853,410	568,949
03-0022	Light Rail Vehicles	106,388,020	40,[illegible],673
03-0024	Purchase 190 New Rapid Transit Cars	27,515,900	16,410,[illegible]
03-0025	Safety	17,882,760	12,185,[illegible]
03-0026	Plant Improvements - Phase II	12,363,050	8,303,820
03-0028	Trackless Trolleys	4,161,335	2,972,768
03-0029	Restoration of Orange Line Structure	5,826,740	4,661,392
03-0031	Plant Improvements - Phase III	17,428,[illegible]0	13,942,[illegible]00
03-0033	Purchase 354 Buses and Vans	17,914,245	14,331,[illegible]96
03-0036	Restoration of Track Support Structures	3,157,820	2,526,2[illegible]
03-0037	Immediate Needs Power	22,388,000	18,710,[illegible]59
03-0040	CRIP I	13,634,000	10,907,2[illegible]
03-0042	Purchase Service Bus Lines	255,600	204,[illegible]
03-0043	Rehabilitation of Everett Maint. Fac.	29,791,475	23,[illegible],[illegible]80
03-0049	Quincy Adams RL Station Complex	33,277,584	26,622,[illegible]67
03-0051	Transit Efficiency	11,172,055	8,[illegible],2[illegible]
03-0053	PCC Rebuild	14,260,070	11,[illegible],[illegible]
03-0054	Power Cable	6,000,000	6,000,000
03-0055	Station Modernization - Phase III	18,437,420	14,[illegible],9[illegible]
03-0057	Track Improvements	49,[illegible],135	39,[illegible],[illegible]
03-0072	35 Commuter Rail Coaches	25,[illegible],275	19,[illegible],[illegible]
03-0078	Plant Improvements - Phase IV	29,237,255	23,[illegible],[illegible]
03-0084	Systemwide Signals/Communications Imps.	14,140,150	11,312,[illegible]
03-0085	Tunnel Rehabilitation - Phase I	19,228,400	15,387,[illegible]
03-0086	Columbia Station Project	958,000	[illegible],[illegible]
03-0088	South Station Project	37,604,300	30,[illegible],[illegible]
03-0090	Kendall Square Station Project	16,[illegible],500	13,231,[illegible]
03-0093	Purchase of 300 New Buses	15,[illegible],360	12,[illegible],[illegible]
03-0104	North Shore Extension	3,125,000	2,[illegible],[illegible]
03-0106	CRIP III (Signalling)	5,006,715	4,[illegible],372
03-0107	Modernization of Transit Cars	37,127,665	29,702,052
03-0111	CRIP IV	8,545,710	6,[illegible],[illegible]
03-0114	Transit Park-Ride	995,040	[illegible],[illegible]
23-9001	South Braintree Extension	56,[illegible],[illegible]	45,[illegible],[illegible]
23-9002	Purchase 190 New Rapid Transit Cars	94,999,[illegible]	76,[illegible],[illegible]
23-9004	Midland Branch Restoration	20,177,100	15,[illegible],[illegible]
23-9005	South Cove Tunnel and Station	33,[illegible],[illegible]	26,[illegible],[illegible]
23-9006	CRIP II	57,[illegible],[illegible]	46,[illegible],[illegible]
23-9007	Southwest Corridor ($783 M)	703,[illegible],[illegible]	[illegible],[illegible],[illegible]
23-9008	Harvard Square to Alewife ($572 M)	543,[illegible],[illegible]	451,[illegible],[illegible]
23-9009	Modernization of Red Line Cars	27,[illegible],[illegible]	22,[illegible],[illegible]
23-9011	CRIP III	25,[illegible],[illegible]	20,[illegible],[illegible]
05-0010	Purchase of 62 Buses	8,[illegible],[illegible]	6,[illegible],[illegible]
05-0018	Purchase of 300 Buses	19,[illegible],[illegible]	15,[illegible],[illegible]
05-0033	Plant Improvements Phase IV - Bus	4,[illegible],[illegible]	3,[illegible],[illegible]
05-0035	Transit Efficiency - Bus	3,[illegible],[illegible]	3,[illegible],[illegible]
06-0002	Haymarket Soils Instrumentation	458,431	305,571
06-0011	Validation Study	667,021	587,618
06-0015	LRV Specifications	155,378	127,411
06-0059	Pre-paid Transit Pass Program	80,000	80,000
06-0091	Station Art Design	70,000	70,000
06-0117	Axle Stress Study	129,000	129,000
06-0121	Rock Charber Study	20,599	20,599
06-0127	Rock Chamber Study	215,769	215,769
06-0130	Emergency Power Supply Study	77,000	77,000
06-0139	Kohn Egg Fasteners Test	249,659	249,659
09-0001	Southwest Corridor Study	746,725	497,817
09-0002	Central Area System Study	783,101	522,067
09-0010	Boston Trans. Planning Rev.	2,540,250	1,591,500
09-0016	Transit Development Program	1,[illegible],000	1,200,000
09-0026	Maint. Productivity Study	170,000	135,000
09-0066	Rail Retrofit Evaluation	88,000	88,000
09-0096	Plant & Facilities Development	275,000	220,000
09-7001	Bus Service Evaluation Study	163,000	130,400
29-9001	Unified Work Program	36,[illegible],000	29,320,000
29-9002	Project Development Tech. Study	2,[illegible],000	2,023,600
90-0003	Section 9A Block Grant FY'83	19,273,750	15,[illegible],000
	SUBTOTAL	$2,771,[illegible],[illegible]	$2,[illegible],837,[illegible]
03-9001	Penn Central Acquisition Loan	$ 19,[illegible],000	$ 19,[illegible],000
23-9010	B & M Acquisition Loan	24,172,750	24,172,750
	TOTAL	$3,815,273,239	$2,247,[illegible],[illegible]

SOURCE: MBTA, "Federal Funding Summary Sheet," 1983.

Table 3-3

TRANSIT CAPITAL-FUNDING SCHEDULE
FY1981-1987+

	FY81	Future Program Total	Annual Element FY1982	2-5 Year Element 1983-1986	FY1987+
TOTAL	319.4	3266.7	380.0	1018.0	1876.6
Federal Share					
Section 3	69.1	2355.11	183.76	648.32	1523.03
Interstate	190.0	297.50	121.04	176.46	0.0
Section 5	7.6	n.a.	6.6	n.a.	0.0
Local Share					
Section 3	17.3	583.34	45.94	162.08	353.57
Interstate	33.5	52.50	21.36	31.04	0.0
Section 5	1.9	n.a.	1.3	n.a.	0.0

SOURCE: Central Transportation Planning Staff, Transportation Improvement Program, 1982-1986. January 31, 1982, p. II-18.

(over 680 route miles), and the rest were undergoing maintenance or minor repair or held in reserve. Of the inactive fleet, 63 were in storage waiting to be sold. Thirteen buses were leased to other operators.

As of 1982, the average age of the active buses was 8.6 years. Some MBTA accounts use 10 years as bus life expectancy, although the federal Urban Mass Transportation Administration standard for average life expectancy uses 12 years. In either case, the fleet as a whole will require heavy replacement and/or repair in the 1980s (MBTA, 1982f, p. 9).

According to an MBTA management report, the goal is to reduce the average age of the bus fleet to 6.0 years by mid-1985 by purchasing 100 new buses each year. (From mid-1982 to early 1983, the average age was reduced from 8.6 to 7.7 years.) In 1977, the MBTA calculated the cost of each bus at $65,000. By January 1982, the cost of purchasing new buses had risen dramatically, with new acquisitions costing about $150,000 per bus, and with FY 1983-86 projected requirements of $78.1 million. This led the MBTA at the end of 1982 to contract out for the rehabilitation of 70 buses, costing $3,134,833 ($44,790 per bus), which is expected to increase bus use for an additional 8 to 10 years (MBTA, 1983c, pp. 77-78; Central Transportation Planning Staff, 1982a, pp. 11-17; Massachusetts EOTC, 1977, Vol. II, Chap. 4, p. 3). On-going major projects for bus and other mass-transit facilities are listed in Table 3-4.

Maintenance Plans and Costs

Garage facilities for MBTA buses as of 1982 were in 8 locations (see Table 3-5), handling 147 routes. There are 254 bus-shelter locations in 32 towns and cities in the MBTA area. The cost of maintaining the bus fleet,

Table 3-4

MAJOR MASS-TRANSIT/BUS-SERVICE
MAINTENANCE AND REPAIR PROJECTS
AS OF 1983

Project	Purpose	Cost	Status
Charlestown Plant Maintenance Project	New bus garage Vehicle maintenance Rail bending Light and heavy maintenance	$37,100,000 Approved	Started 1975, to be complete in mid-1984
Everett Maintenance Improvements Project	Renovate MBTA main repair facility	$29,700,000 Approved (including $13,300,000 in federal funds)	Started 1978, to be completed in 1984
Reservoir Reconstruction Complex	Reconstruction of Reservoir carhouse and yard complex	Received $60 million	Started 1972; Phase I complete; Phase II to be complete by late 1984
Bartlett Street Garage	Rehabilitation of garage for Southwest bus area	$5 million	70% complete; to be finished by April 1983
Cabot Bus Garage	Washer and site improvements	$500,000 Approved	To be completed May 1983
Lynn Bus Garage	Site work and reconstruction	$1.6 million Approved	To be completed June 1983
Quincy Bus Garage	Site work and renovations	$2.5 million Approved	To be completed July 1983
Albany Street Garage	Site work and renovations	$1.2 million Approved	To be completed July 1983
South Boston Bus Waiting and Dispatching Facility	Site work and new building structure	$230,000 Approved	Final design complete; construction to begin January 1983

Table 3-4 (continued)

Project	Purpose	Cost	Status
Station modernization	Originally design and engineering of 9 Red Line stations, later Suffolk Downs Blue Line station and modernization of Kenmore Square station	$24 million Approved	First funded 1978, final completion pending unspecified additional funding
Plant Improvement	Numerous small scale mass transit projects	Phase I,II, III approved for $36.9 million; Phase IV approved for $29.2 million; possible Phase V projects	First 3 phases 80% complete, final phase by 1984

SOURCE: MBTA, January 21, 1983, pp. 92-95.

Table 3-5

MBTA BUS GARAGE/STORAGE FACILITY (1982)

Garage/Storage Facility	No. of Vehicles	Avg. Age	No. of Routes	Avg. Seats	Value of Facility ($000)
Albany Street	114	4.9	15	51	$2,288
Cabot	214	8.5	22	45	1,468
Arborway	200	6.6	22	46	940
Somerville	n.a.	7.5	21	n.a.	2,298
Fellsway	74	13.7	11	44	n.a.
Charlestown	247	7.5	15	45	n.a.
Lynn	113	10.2	24	47	1,717
Quincy	87	9.0	17	46	n.a.
Total	1049	816	147	46	n.a.

SOURCE: MBTA, Title VI Assessment for Capital and Operating Assistance, December 1982, Exhibit E and Table 4.1.

MBTA-Systems, "Treasurer's Office Replacement Costs," 1983.

The MBTA Budget 1983/FY84, pp. 34, 45, lists seven garages operating 152 routes for 987 buses.

n.a. = not available
Avg. = Average

along with 400 nonrevenue vehicles, in FY 1984 was estimated at $21.5 million (MBTA, 1982b, p. 86; MBTA, 1982f, Exhibit H).

Purchase Plans and Costs

MBTA plans to purchase 100 new buses per year over the next four years (1983-1987); this will require an outlay estimated at about $60 million. However, there are no known studies by the MBTA on precisely what mix of purchase and/or rehabilitation will take place over this period with respect to growth or decline of ridership, nor are there estimations of bus-service costs at various standards of service.

Rapid Transit

The MBTA rapid transit system, the subway, which has the largest share of public transportation fare box revenue, operates on three routes: the Red, the Orange, and the Blue Lines. The Green Line, which operates surface vehicles as well as subway transit, is generally treated separately from "rapid transit," although, because of its overlapping operations (maintenance, system connections, etc.), its budgetary items often appear together with the Red, Blue, and Orange Lines. Recent years have found increasing ridership on the MBTA system overall, adding to the need to maintain and upgrade it to the standard of a reliable and efficient mode of transportation.

Facilities and Age

Together, the three lines consist of 41.6 route miles (one way), in addition to 8.4 route miles under construction, 15 miles of subway track (one way), and 48.2 miles of track on bridges, elevated, or surface areas (MBTA, 1982a, p. 36). The three lines utilize 354 cars and have 56 stations. The value of the rapid transit/Green Line system is given in Table 3-6. For a

Table 3-6

VALUE OF RAPID-TRANSIT/GREEN-LINE STATIONS

Line	Value (1983 $)
Red Line[1]	$ 73,557,668
Blue Line[2]	7,733,147
Orange Line[3]	28,777,440
Green Line[4]	1,184,720
Total	$111,252,975

[1]Harvard/Brattle, Northwest Extension, Park, Washington, and Shawmut not included.

[2]Bowdoin, State, Aquarium and Maverick not included.

[3]Essex, Washington, State, Haymarket, and North Station not included.

[4]Only North Station, Science Park, and Lechmere included.

SOURCE: MBTA Systems, "Treasurer's Office Replacement Costs," 1983.

general index of rapid transit/Green Line facilities, see Table 3-7.

The cost of maintaining the rapid transit system derives from no specific long-term program, and maintenance is carried out largely on a day-to-day emergency-management basis. The MBTA rail system has never had a long-term maintenance program (Massachusetts EOTC, Vol.II, 1977, Chap. 2, p. 2).

Construction Plans and Costs

Construction over the past decade, amounting to $2 billion, has been approximately 80 percent funded by the federal government with the other 20 percent raised by MBTA long-term bonds. (See Table 3-8.) The Urban Mass Transportation Administration (UMTA) funds on-going projects on a "cash" basis, authorizing payment only for bills and invoices due and payable.

One of the largest MBTA expansion projects is the $574 million Red Line Extension Northwest, a 3.5 mile subway extension between Harvard Station and Alewife that includes 4 stations, 3.5 miles of twin tunnels, and a 2000-car garage at Alewife Brook Station. It is scheduled for completion by 1984. A $792 million Southwest Corridor Project on the Orange Line is the largest construction project in Boston's history, which will include nine new stations and was scheduled for completion by late 1986, now postponed to 1987. A third major rapid-transit project in terms of cost is the construction of the $33.2 million Quincy Adams Station on the Red Line, which was scheduled for completion by the end of 1982, but is currently slated to open in September 1983 (MBTA, 1983c, p. 88).

Long-term power projects include the UMTA-assisted "Power System Improvements Program" for upgrading the MBTA's traction-power generation and distribution system with an approved project budget of $88.6 million, now 60

Table 3-7

MBTA RAPID-TRANSIT/GREEN-LINE VEHICLE AND TRACK STATISTICS, 1983

Rapid Transit Line	Cars	Avg. Age	Route Miles (1 way)	Track Miles (1 way)	Revenue Track Miles	S/T* Track Mileage	Bridge Track Miles	ROW,** Paved Streets	Car Houses, Yards Mileage	Stations
Red Line	164	16.1	24.6	50.8	38.1	10.5	--	21.6	7.9	20
Blue Line	70	2.5	6.2	18.0	13.6	4.5	--	9.1	4.4	12
Orange Line	120	1.2	10.8	36.8	26.3	3.5	--	13.1	6.4	16
Green Line	225	21.8	35.1	83.3	58.8	10.5	--	53.7	8.0	33
Total	579	14.2	77.4	188.9	136.8	29.0	48.2	97.5	26.7	81

* Subway/Tunnel

** Right-of-Way

SOURCES: MBTA, Budget 1983/FY1984, October 1, 1982, p. 34.
MBTA, Title VI: Assessment for Capital and Operating Assistance, December 1982, Exhibit D.
MBTA, Annual Report, 1981.
MBTA, Engineering and Maintenance Department, Track and Structures Summary Report, 1983.

Table 3-8

RAPID-TRANSIT RAIL EQUIPMENT/
GREEN-LINE REQUESTED MAINTENANCE
1983/FY1984

Title	1983* (6 months)	1984* (12 months)	Total Cost**
Rail Equipment	$ 9,493,600	$18,987,200	$28,480,800
Green Line	4,919,788	9,801,119	14,720,907
Total 1983/1984	$14,413,388	$28,788,319	$43,201,707

*1983=1/1/83-6/30/83
1984=7/1/83-6/30/84

**Includes revenue and nonrevenue vehicles

SOURCE: MBTA, "Rail Equipment: 1983 and FY1984 Budget Request," August 6, 1982.

percent completed; an UMTA-assisted "Immediate Needs Project" budgeted at $22.4 million to continue to operate the power-generation facility in South Boston; and an UMTA-funded $14.4 million "Power Cable Replacement Program," now 60 percent complete. As a whole, the Power Program will require an additional 10 years and $70 million to replace and upgrade cable conduits and power-distribution facilities (MBTA, 1983c, pp. 88-89).

Other major rapid-transit projects are the "Track Improvements Program" and the "Tunnel Rehabilitation Program," initiated with UMTA in 1977 and 1979, respectively. Track upgrading and replacement on the three rapid-transit lines and the Green Line will cost $49.9 million, of which UMTA has already provided $18.3 million (in 1981 and 1982). The "Track Improvements Program," now 40 percent complete, will require ten additional years and approximately $80 million. The other project is to repair tunnel deterioration throughout the system and to install new ventillation equipment. Thus far, federal funds have provided $15.3 million for tunnel rehabilitation, with additional funds approved for ventillation shafts at two stations. Over the next three years, $25 million is required for new ventillation shafts in the Green Line Central Subway. A systemwide "Ventillation Program" is anticipated to cost about $75 million, the time and completion date pending federal funding (MBTA, 1983c, pp. 89-90).

The Red, Blue, and Green Lines are also part of a major combined rapid-transit and streetcar signal/communication upgrading project, for which $14.1 million has already been approved. The funding is expected to be scheduled over several years. Additional funding of $75-80 million is said to be needed in the next five years for the following (MBTA, 1983c, p. 91):

Green Line Signals	$27-35 million
Blue Line Signals	$21-25 million

Communications	$8-10 million
Bus Radio	$8-10 million

For other major upgrading projects involving mass transit and/or bus service, see Table 3-2.

The Green Line

The Green Line is separate from the rapid-transit division of the MBTA because of its streetcar vehicle (LRVs and the older PCC cars) operations and its responsibility for trackless-trolley maintenance. (See Table 3-9.)

The Boeing LRVs delivered in 1976 proved to be highly unreliable, and over 40 were eventually stripped for spare parts. Operation and safety problems made it necessary to institute single-car operations until better coupler assemblies are provided. More recently, a court settlement was litigated against Boeing, resulting in a $40 million award to the MBTA, which plans to use the money to purchase new light rail vehicles. As of early 1983, the MBTA was in the process of rehabilitating at least 120 LRVs and 34 PCCs and intended to purchase an additional 55 new vehicles (MBTA, 1983c, pp. 72-73; interview with Jim Atkinson, EOTC Assistant Secretary, May 18, 1983). Expansion and modernization projects of the Green Line were discussed in previous sections.

Among the MBTA area transportation modes, trackless trolley remains a fixture. In peak operating condition, their appeal includes a smooth, quiet ride, the absence of in-route pollution, their limited facility requirements, the relatively easy maintenance of their electric motors, the flexibility of power sources, and their apparent general popularity (usership) with the public. Trackless trolley service consists of 4 routes, 50 vehicles, and 15.75 route miles (one way).

Table 3-9

THE GREEN LINE, 1982

	LRVs	Streetcars*	Trackless Trolley
Number of Cars	125	100 (21.8)**	50 (6)**
Number of Routes	5		4
Route Miles	35.1		15.75
Track Miles	50		--
Stations	27		--

* Generically, "streetcars" also inciudes LRVs. In this case, however, "streetcars" refers only to the older (Presidential Commission Car) vehicles.

** Average age.

LRV = Light rail vehicle.

SOURCE: MBTA, October 1, 1982, pp. 34,42; MBTA, December 1982, Exhibit E.

Commuter Rail

Today about 35 percent of total railroad route mileage in the Commonwealth is used to provide transportation for a 9 million (and growing) annual ridership of daily commuter or intercity passenger community, in addition to piggy-backed freight service. Rail transportation, however, has long suffered from lack of planning, private-sector speculation, and unregulated competition from other transportation sectors. The advent of aviation and the automobile continually diminished ridership and service from as early as 1910. The creation of the MBTA in 1964 was, in fact, in part to salvage commuter-rail service by providing subsidies to lines in or near bankruptcy, and since 1976 all commuter-rail service has been subsidized (Massachusetts EOTC, 1982b, pp. II-1 through III-3). The public subsidies provided to commuter rail in the MBTA area, in effect, also provide subsidies to the private sector's use of the rails for freight transport.

Facilities

Currently, and at least until December 31, 1986, all commuter rail in and out of Boston is scheduled to be run and controlled by the MBTA under contract with the Boston and Maine Corporation, an outcome of the series of bankruptcies and sellouts in the 1960s and 1970s (Massachusetts EOTC, 1982b, p. III-3). Of the 310.3 route miles connected to the MBTA, active commuter-rail lines (including outer state connections), 239.9 route miles (77 percent) are owned by the MBTA. Including long side tracks, sidings, and yards, the MBTA owns a total of 906 track miles. All planning for commuter rail also takes place under MBTA jurisdiction.

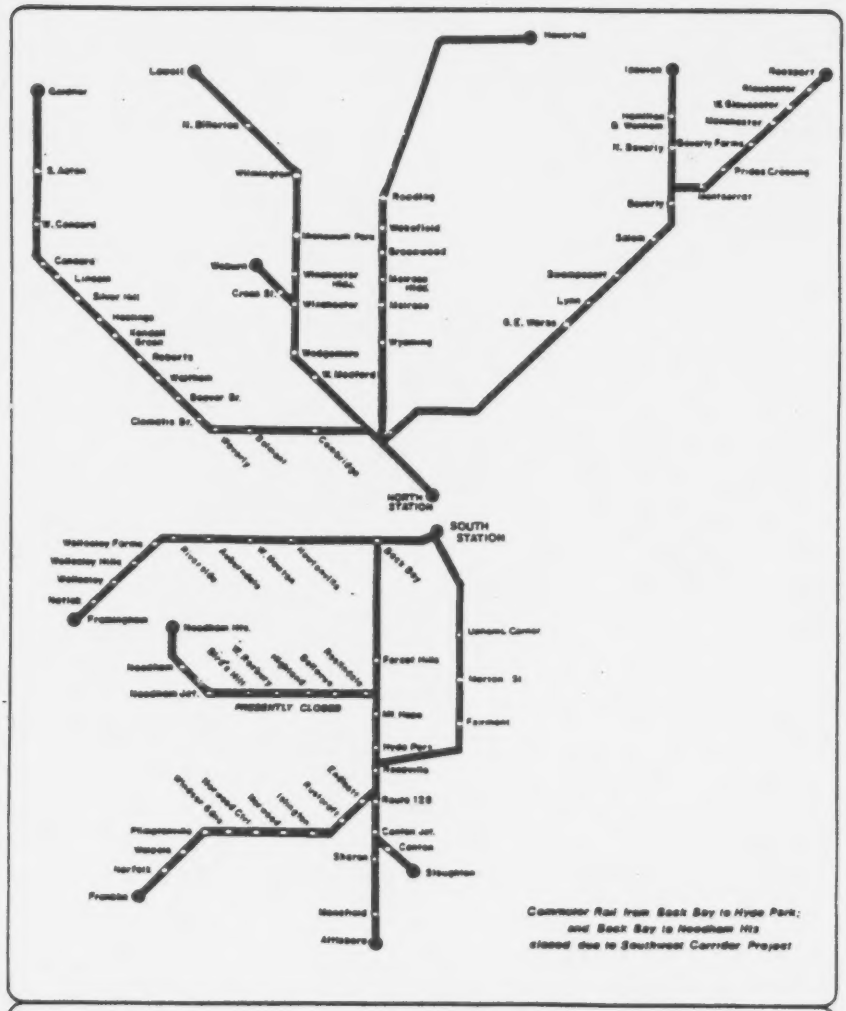
There are two distinct central terminals from which commuter rail traffic flows in and out of Boston: the North Station and the South Station.

These reach out with approximately 270 daily commuter trains to 10 different main line or branch line terminals and 77 stations. (Refer to Figure 3-1.) In addition to the 239.9 route miles of active commuter lines, the MBTA also owns 250 route miles that do not currently carry passenger service (MBTA, 1981a; MBTA, 1981b, Vol. 1, pp. 1-1, 1-2; CTPS, 1979, pp. 39-43). A general inventory of commuter-rail facilities is found in Table 3-10.

Maintenance of rolling stock takes place at the MBTA-owned Boston Engine Terminal built in 1890 and the Billerica Shop (formerly shared with the B&M freight operation) where most of the heavy repair work is performed. Rolling stock on daily weekday operations consists of 38 locomotives, 143 coaches, and 13 self-propelled Rail Diesel Cars (RDCs), all owned by the MBTA (Table 3-11), except for 11 locomotives leased from the Boston & Maine (B&M), and 43 coaches leased from the Toronto Area Transportation Operating Authority (MBTA, 1981b, Vol. 1, pp. 1-1, 1-2). In total, the MBTA owns 75 percent of commuter rail locomotives, 100 percent of coaches, 82 percent of track, 89 percent of stations, and 100 percent of shop facilities (MBTA, 1981b, Vol. 2, Exhibit IV-1).

Maintenance Plans and Costs

The condition and capacity of track and facilities vary. (See Table 3-12.) Taken over by the MBTA from the B&M and Penn Central in the 1970s, commuter rail has had different degrees of deferred maintenance. There is also variance because some lines, such as the Shore Line or Framingham Line were built for higher speeds, while others were restricted to 30-40 mile limits, which, in effect, imposed conditions of limited track use by modern commuter rail vehicles. In general, when compared against peer-group regional transportation systems, although the MBTA fell behind in some service


NORTH STATION
SOUTH STATION
PRESENTLY CLOSED
Commuter Rail from Back Bay to Hyde Park;
and Back Bay to Needham Hts
closed due to Southwest Corridor Project

SOURCE: Central Transportation Planning Staff. 1982. "Transportation Improvement Program; 1982-1986." (January 31), p. IV-11.

Figure 3-1. 1982 Commuter Rail Network

Table 3-10

COMMUTER RAIL INVENTORY, 1981

	MBTA Operated Route Miles	MBTA Operated Main Track Miles	No. of Tracks	No. of Stations	Total No. of Grade Crossings	No. of O.H. Bridges	No. of U.G. Track Bridges	No. of Culverts	Maximum Track Speed
Northside									
East Route Main Line	27.8	49.2	2/1	9[a]	29	29	24	70	60
Gloucester Branch	16.6	29.2	2/1	7	27	7	11	62	60
West Route Main Line	31.1	46.3	2/1	13	34	28	34	88	60
New Hampshire Main Line	25.4	50.8	2	7	2	41	19	126	60
Fitchburg Main Line	64.0	119.3	2	17	56	68	54	363	60
Southside									
Framingham Main Line	21.5	43.0	2	8	2	63	10	126(est)	50
Franklin Branch	18.5	23.8	2/1	9[b]	7	14	22	30	60
Shore Line	24.7	57.7	4/2	9[b]	1	31	18	144(est)	79
Stoughton Branch	4.0	4.0	1	2	9	0	5	9	30
Dorchester Branch	8.8	17.7	2	1	0	16	26	24(est)	60
Totals	242.4	441.0		82	167	267	200	932	

[a] Includes North Station.

[b] Includes South Station and Back Bay Station.

Track miles maintained by B&M 322.6
Track miles maintained by Amtrak 75.4
Track miles maintained by Conrail 43.0

B&M = Boston and Maine Railroad
MBTA = Massachusetts Bay Transportation Authority
O.H. = Overhead
U.G. = Underground

SOURCE: MBTA, "Commuter Rail Summary Sheet," November 16, 1981.

Table 3-11

COMMUTER RAIL ROLLING STOCK (1981)

Type	Number	Notes
F-40 locomotive	13	Five on order
5-10 locomotive	19	
GP-17 locomotive	12	Leased from B&M, 5 to return to B&M upon receipt of new F-40s
E-8 locomotive	1	
Switch engine	1	Leased from B&M
Self-propelled RDC	14	
Loco-hauled RDC*	43	
Pullman standard coaches	60	
Coaches	56	Leased from TOTOA until May 1981
Steam coaches	20	

*Also 36 RDCs are to be converted to "loco-hauled" service.

B&M = Boston and Maine Railroad
RDC = Rail Diesel Car
TOTOA = Toronto Area Transportation Operating Authority

SOURCE: MBTA, June 15, 1981, Vol. 1, Exhibit 2.

Table 3-12

1983 MBTA COMMUTER RAIL OPERATED RAIL LINES (Roadways)[6]

Rail Line	Starts - Terminates	Rail[1]			Ties[2]			Ballast			Signals[9]				
		Age	Condition	Repair or Replace	Age	Condition	Repair or Replace	Years Since Cleaned	Condition	Repair or Replace	Age	Condition	Repair or Replace	Add CTC [1]	Add Cab Sig.[2]
East Route Main Line	Boston - Ipswich	30-65 yrs.	Fair-Poor	1984-1987	3-55 yrs.	Fair	1983-84	40	Fair-Poor	1984-86	40+ yrs.	Fair-Poor	1983	1984-85	1990-2000
Gloucester Branch	Beverly Jct. - Rockport	30-76 yrs.	63% Good 36% Poor	36%-1983	2-35 yrs.	Good	1988	2	Good	2006	40+ yrs.	Poor	1982-83	1987-88	1990-2000
West Route Main Line	Boston - Haverhill	22-63 yrs.	Fair-Poor	13%-1984 [3] 24%-1987	3-40 yrs.	Good	1987	35	Fair-Poor	1986	37 yrs.	Good-Fair	1980	1986-87	1990-2000
New Hampshire Main Line	Boston - Lowell	34-56 yrs.	16% Good 84% Fair-Poor	18%-1985 42%-1985-87	3-40 yrs.	Fair-Poor	1983	40	Fair-Poor	1985	32 yrs.-40% 2-yrs.-60%	Good&Poor	1982-83	1985-87	1990-2000
Fitchburg Main Line	Boston - Gardner	1-54 yrs.	34% Good 66% Fair-Poor	10%-1984 [3] 23%-1986-87	2-45 yrs.	72% Good 28% Fair	1988 1985	35	Fair	1987	50 yrs.	Good&Poor	1981-84 1983-88	1985-86	1990-2000
B & A Main Line	Boston - Framingham	20-50 yrs.	Fair-Good	1986-2000	1-35 yrs.	Good	1986	20	Good-Fair	1988	1-30 yrs.	Good	1981	50% Existing 50% 1985	1990-2000
Franklin Branch	Readville - Franklin	1-50 yrs.	51% Good 49% Poor	49%-1983	1-35 yrs.	Good	1989	1	Good	2007	31% Yrs [3] 69%-49%	Fair	31%-1984 49%-1986	1984-86	1990-2000
Shore Line	Boston - Attleboro	15-30 yrs.	95% Good 5% Fair	5%-1984-85	4-45 yrs.	Good	5%-1984-85	4	Good	2004	40+ yrs.	Fair	20%-1982-83 10%-1985-86	1983-88	Existing
Stoughton Branch	Canton Jct. - Stoughton	50 yrs.	Fair-Poor	1988	3-40 yrs.	Good-Fair	1987	Never	Poor	1983	None [9]	—	1985	1985	1990-2000
Dorchester Branch	Boston - Readville	3 yrs.	Good	-	4-35 yrs.	Good	1986	4	Good	2004	3 yrs.	Good	1980	1980	1980

1. CTC = Centralized Traffic Control System
2. Cab Sig. = Cab Signal System w/ Overspeed Control
3. Remainder of Rail Replacement is Responsibility of B&M Railroad (Conditions of Purchase & Sale Agreement)
4. Normal Life in Commuter Rail Service When Well Maintained - 50 Years.
5. Normal Life in Commuter Rail Service When Well Maintained - 35 Years/After Initial Deferred Replacements are Accomplished/on Average of 650 per Track Mile are Replaced Every 7 Years.
6. Commuter Rail Track Requires Resurfacing and Realigning Every 5 Years and Spot Surfacing Every 2½-3 Years.
7. 12 Miles Unsignaled.
8. Unsignaled.
9. Safety Level Always Maintained to Federal Standards.

SOURCE: MBTA, Railroad Operations Directorate (Summary Sheet), 1983

categories, it was above average in areas such as age of equipment and some allocation measures (MBTA, 1981b, Vol. 1, pp. 2/3-1 through 2/3-8).

Construction Plans and Costs

Since the creation of the Urban Mass Transportation Act of 1964, the federal government has been deeply involved in financing urban-rail systems. Federal grant awards for the MBTA rail system have increased from $6 million in 1965 to a high in 1980 of almost $318 million. Rail-modernization programs under UMTA grants, which provide 80 percent of project costs, amounted to $63 million in 1982. Costs of the "Commuter Rail Improvement Program" phases are indicated in Table 3-13. In addition, an "urban initiatives" program, also UMTA-funded, has to date provided $30 million ($14 million in 1982) for the rehabilitation of South Station. The Reagan administration plans to eliminate this program. Specified UMTA section 5 funds, also directed toward bus and system-wide operating assistance, has a separate allocation for commuter-rail operating assistance, which amounted to $6.3 million in FY1982. Of the $2.2 billion in federal grants to the MBTA (1965-1982), commuter rail has received about 8 percent (MBTA, 1983c, pp. 103-108).

The grants from UMTA provide the primary source of funding for commuter rail. The local funding share is appropriated through the sale of bonds by the MBTA, which in the 1970s took over more than 380 miles of railroad lines formerly owned by the Penn Central Transportation Co. and the Boston and Maine Corporation. The future of the state-run commuter rail system, a number of MBTA managers say, is dependent on the continuing support of the federal government, through such programs as the UMTA grants. Given the uncertainty of this support, EOTC reports tend to discuss fiscal plans of the state-wide rail system in short-term efforts, which include "only a very

Table 3-13

COMMUTER-RAIL IMPROVEMENT PROGRAM (CRIP), 1975-1981
(current dollars)

Project	Date	Cost
CRIP I	1975	$13,600,000
CRIP II	1976	57,800,000
CRIP III	1978	25,300,000
CRIP IV	1981	8,400,000
TOTAL		$105,100,000

SOURCE: MBTA, January 21, 1983, pp. 90-91.

limited number of rehabilitation projects" (EOTC, State Rail Plan Update, 1981-1982, p. IX-2.)

The future of rail improvement is thus constrained by funding limitations. Under discretionary UMTA Section 3 funding, over $160 million was initially proposed for Rail Modernization in FY1982, but only $63 million was allocated. For the FY1983 Rail Modernization program, over $175 million was initially proposed against the prospect of federal budgetary cutbacks for mass transit (MBTA, 1983c, pp. 109-110). Proposed rail improvements for FY1984 are valued at $10 million (MBTA, 1983f, Exhibit B). A trimmed $200 million five-year improvement program (1983-1987) has also been recently proposed, but, according to the staff at the EOTC, it has not been funded. (See Table 3-14.)

The condition of commuter-rail facilities, as seen in Table 3-12, ranges from good to poor. Of the 10 rail lines, 8 will require heavy repair or replacement of rails, which is in many cases well beyond their 50-year life expectancy, within the next five years. Repair or replacement of ties, ballast, and signals will also need substantial rehabilitation in the same time frame. These requirements suggest heavy labor and material costs in the near future. Over the next five-year period (1983-1987), a scaled down $200 million "Commuter Rail Improvements to Existing Services Program" has been proposed "to eliminate safety hazards, increase ridership and revenues, and decrease costs (MBTA, 1983d, p. 1). See Table 3-14 for a summary of the five-year project. The present conditions are below satisfactory standards, and the public is expected to make greater demands for improved service, which, in turn, will bring pressures for greater expenditures and subsidization.

Table 3-14

5-YEAR COMMUTER-RAIL IMPROVEMENTS
SUMMARY OF COSTS (1983-1987)

Item	Cost ($000)
Track Projects	$ 46,390
Signal Projects	22,783
Purchase M/W Equipment	4,551
Shops and Buildings Projects	5,898
Bridge Projects	12,587
Station Improvement Projects	3,720
Station Platform Improvements Projects	5,406
Parking Expansion Projects	6,930
New Locomotives and Coaches	91,774
TOTAL	$200,039

SOURCE: MBTA, "1983 Commuter Rail Improvements to Existing Services Program," 1983.

STATE-OWNED RAILROAD GRADES AND CROSSINGS

Railroad grades and crossings in the Massachusetts Commonwealth are maintained by the Massachusetts Department of Public Works (MDPW). Projects for 1982 and 1983 are listed in Table 3-15. Most of the costs of providing grades and crossings (90 percent) comes under federal provision. From January 1975 to March 1983, the MDPW listed 387 needed railroad-crossing projects in the Commonwealth with budgeted outlays for these of $33.1 million, of which $26 million had actually been spent, and the rest of the funding was deferred, postponed, eliminated, or tied up. For 1983, proposed spending for highway/railroad grade crossing projects amounts to over $3 million. (See Table 3-15.) Long-term plans and projections of expenditures are unavailable.

STATE-OWNED RAILROAD BRIDGES AND TUNNELS

The state of Massachusetts owns or partly owns 25 of the 420 railroad bridges and tunnels in the Commonwealth, according to the staff at the Massachusetts Department of Public Works. These 25 bridges and tunnels are rated collectively as "bridges," inasmuch as federal assistance is given only to that category. Of the 25 "bridges," 21 are state-owned (MDPW), and 4 are jointly owned by private railroad companies and the MDPW. Their condition is rated by the MDPW as follows: 1 is rated as being in "somewhat better than minimum adequacy to tolerate being left in place as is"; 12 meet "present minimum criteria"; 5 are "better than present minimum criteria"; and 7 are "equal to present desirable criteria." In other words, 18 (72 percent) of the state-owned bridges and tunnels are rated as less than "desirable." There are no data available on repair or replacement of bridges and tunnels (MDPW, 1983; U.S. Department of Transportation, 1979, p. 31). As with much of the mass transportation system, attention to facilities appears to operate on the basis

Table 3-15

RAILROAD/HIGHWAY GRADE CROSSING PROJECTS
1982 AND PROPOSED 1983 COSTS

Railroad Company	1982 Cost	1983 Proposed
Providence & Worcester	$ 403,044	$ 190,000
Central Vermont	--	131,000
MBTA	1,182,681	1,175,000
B&M	929,467	695,000
Conrail	627,000	720,000
Grafton & Upton	--	272,700
Total	$3,142,192	$3,183,700

SOURCE: MBTA, Summary Sheet, 1982 (revised).

of emergency management rather than on well-defined and regular repair and replacement programs.

REGIONAL TRANSIT AUTHORITIES

The Regional Transit Authority (RTA) program, created in 1973, handles transportation needs in 14 districts, including 154 cities and towns, annually serving some 32 million people in the Commonwealth outside the MBTA area.

Facilities

Their services include fixed-route bus service, general paratransit, specialized services for the elderly and handicapped, and commuter rail service to and from Boston. Inasmuch as commuter rail has been discussed earlier, the focus here will be on the major mode of RTA transportation, the bus service.

Maintenance Plans and Costs

As can be seen from Table 3-16, the RTAs operate under heavy subsidies, over $20 million statewide in FY1982, with the revenue-to-cost ratio at 30 percent in FY1982. With "Proposition 2 1/2," it is not easy for planners to project expansion of current transportation facilities, even financing to keep the system at current operating levels. For the next 5 years (1983-1987), however, EOTC planner Howard Taub projects the need for bus replacement at between $25.0-27.5 million per year, based on RTA reported needs of 30 buses per year, inflation estimates of 5 percent, 7 percent, or 10 percent, and deferred purchases of buses (currently at $150,000 per bus) during that period. Given falling federal support, rising ridership (20 million in 1976, 35 million in 1981) and rising cost/revenue mile ($1.63 in 1976, $2.31 in 1982), the RTA bus system as a whole faces an uncertain future.

Table 3-16

RTA FIXED-ROUTE SERVICE, FY1982

	Cost	Revenue	Subsidy	New Rehabilitation Needed[1]	Rehabilitation Cost	Buses Available	Buses Needed[2]	Bus Costs[3] ($000)
Berkshire Regional Transit Authority	$1,186,488	$ 518,277	$ 668,211	--	--	18	2	$ 300
Brockton Area Transit Authority	4,170,000	1,025,000	3,145,000	--	--	45	--	--
Cape Ann Transportation Authority	278,600	40,366	238,234	--	--	4	--	--
Cape Cod RTA ("Not Applicable")	--	--	--	Garage: Fence	305,000 10,000	--	--	--
Franklin RTA	100,644	14,055	86,589	--	--	--	--	--
Greater Attleboro-Taunton RTA	598,692	119,360	479,332	Parking; Garage	200,000 1,350,000	9	2	300
Greenfield-Montague Transportation Area	298,895	78,801	220,094	Garage Repair	15,000	6	3	450
Lowell RTA	1,315,629	487,861	827,768	--	--	36	--	--
Merrimack Valley RTA	1,273,961	295,443	978,518	--	--	27	--	--
Montachusett RTA	1,012,764	218,880	793,884	Garage	335,000	11	--	--
Pioneer Valley Transit Authority	8,966,846	2,835,386	6,131,460	Garage	2,000,000	217	53	7,950
Southeastern RTA	5,118,309	1,165,964	3,952,345	--	--	85	58	8,700
Martha's Vineyard Transit Authority	76,500	9,000	17,500	--	--	--	5	750
Worcester RTA	4,764,522	1,937,623	2,826,899	Garage	200,000	68	35	5,250
Total	$29,111,850	$8,746,016	$20,365,834		$4,415,000	526	158	$23,700

[1] Not yet appropriated for FY1984-FY1988.
[2] Based on bus life of 12 years; needed over next 5 years.
[3] At 1983 costs.
RTA = Regional Transportation Authority.

SOURCE: Massachusetts EOTC, Regional Transit Authority Operations Report, 1981-1982.

HIGHWAY BRIDGES

Highway bridges in Massachusetts are divided among eight districts and are the administrative responsiblity of the Massachusetts Department of Public Works (MDPW), municipalities (cities and towns), the Metropolitan District Commission (MDC), and the Massachusetts Turnpike Authority (MTA). A small percentage of bridges are privately owned. The MDPW and the municipalities are responsible for the greatest number of bridges, 53 percent and 28 percent, respectively.

Facilities, Age, and Current Conditions

According to the MDPW (interview, March 1983) and The Road Information Program (TRIP) (TRIP Report, August 1982), there are about 5000 highway bridges in the state of Massachusetts. (Refer to Table 3-17.) Approximately 2800 or 56 percent are under state (MDPW) jurisdiction; 32 percent are under municipal jurisdiction, and the remaining 12 percent are under the jurisdiction of the Metropolitan District Commission (MDC), the Massachusetts Turnpike Authority (MTA), or private owners.

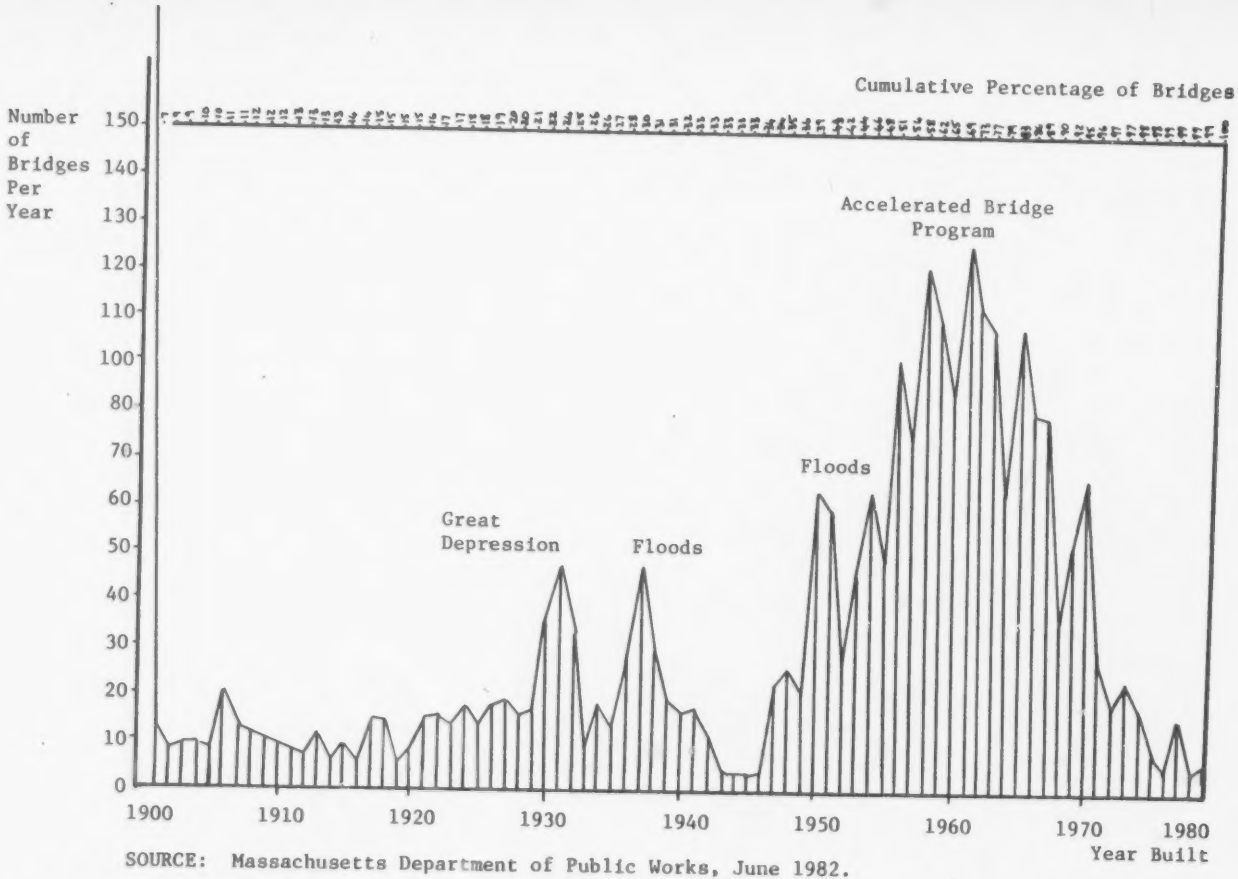
Highway bridges in Massachusetts are as old as 80 years and as young as a few years, with the average age being about 40 years. As shown by Figures 3-2 and 3-3, bridge building, since the turn of the century, has occurred in spurts and always in response to crises. During the Great Depression, as many as 49 state-owned and 36 municipally owned bridges were built in a single year as a result of the jobs programs implemented as part of the New Deal. The average number of bridges built in each year prior to the Great Depression was 12 state and 8 municipally owned. During the latter half of the 1930s, there was severe flooding in the state; as many as 48 state and 36 municipal bridges were built in one year (1937 and 1939, respectively).

Table 3-17

HIGHWAY BRIDGES--EXISTING FACILITIES

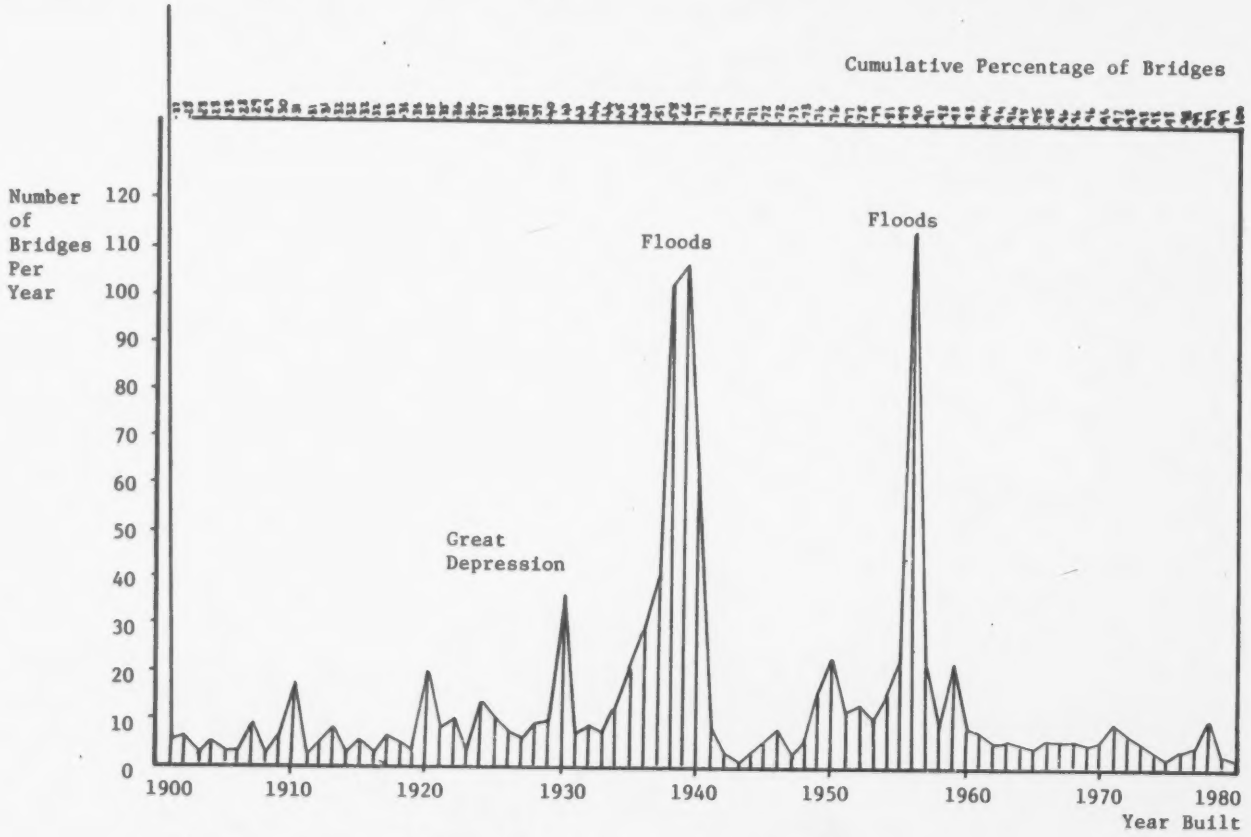
Jurisdiction	Federal Aid System	Nonfederal Aid System	Total
MDPW	2496	272	2768
Municipal	681	--	681
Town	--	856	857
MTA	317	47	364
MDC	108	8	116
Other	4	10	14
Total	3606	1193	4799

SOURCE: Massachusetts Department of Public Works, July 21, 1982.



SOURCE: Massachusetts Department of Public Works, June 1982.

Figure 3-2. Number of State-Owned Bridges Built Per Year



SOURCE: Massachusetts Department of Public Works, June 1982

Figure 3-3. Number of City-Owned Bridges Built Per Year

Hurricane and flood damage forced municipalities to build 120 bridges in 1956. Many of the state's bridges were built between 1950 and 1970 during the time of the state's accelerated bridge program. The MDPW built about 63 percent of the total number of its bridges during this period. Bridges built from 1950-1970 represent a major source of problems experienced today because they all now require substantive maintenance or reconstruction. Older bridges face these same needs.

The major source of information on the condition of the state's highway bridges is the MDPW. A sufficiency scale has been developed by the American Association of State Highway and Transportation Officials (AASHTO) for the purposes of measuring bridge deficiencies and establishing renewal funding priorities. (Refer to Table 3-18 and Figures 3-4 and 3-5.) On the sufficiency scale of 0 to 100 from poorest to best condition, the MDPW (interview, March 1983) indicates that 2,547 (50 percent) bridges fall below a rating of 80. Of these bridges, 1,506 (30 percent) fall within the range of 50-80 on the scale. These bridges are said to have deteriorated to a point of needing "major preventive maintenance or substantial rehabilitation" (TRIP Report, August 1982, p.4). The remaining 951 (20 percent) bridges fall below 50 on the sufficiency scale. These bridges are said to require "immediate rehabilitation or replacement" (TRIP Report, August 1982, p.4).

Maintenance Plans and Costs

No specific maintenance plans are available.

According to officials at the MDPW, there are insufficient financial resources available to upgrade and maintain the state's bridge system. At an average cost of $200,000 per bridge for some 2,525 in need of repair and $500,000 per bridge for some 1019 considered critical, the annual cost of a

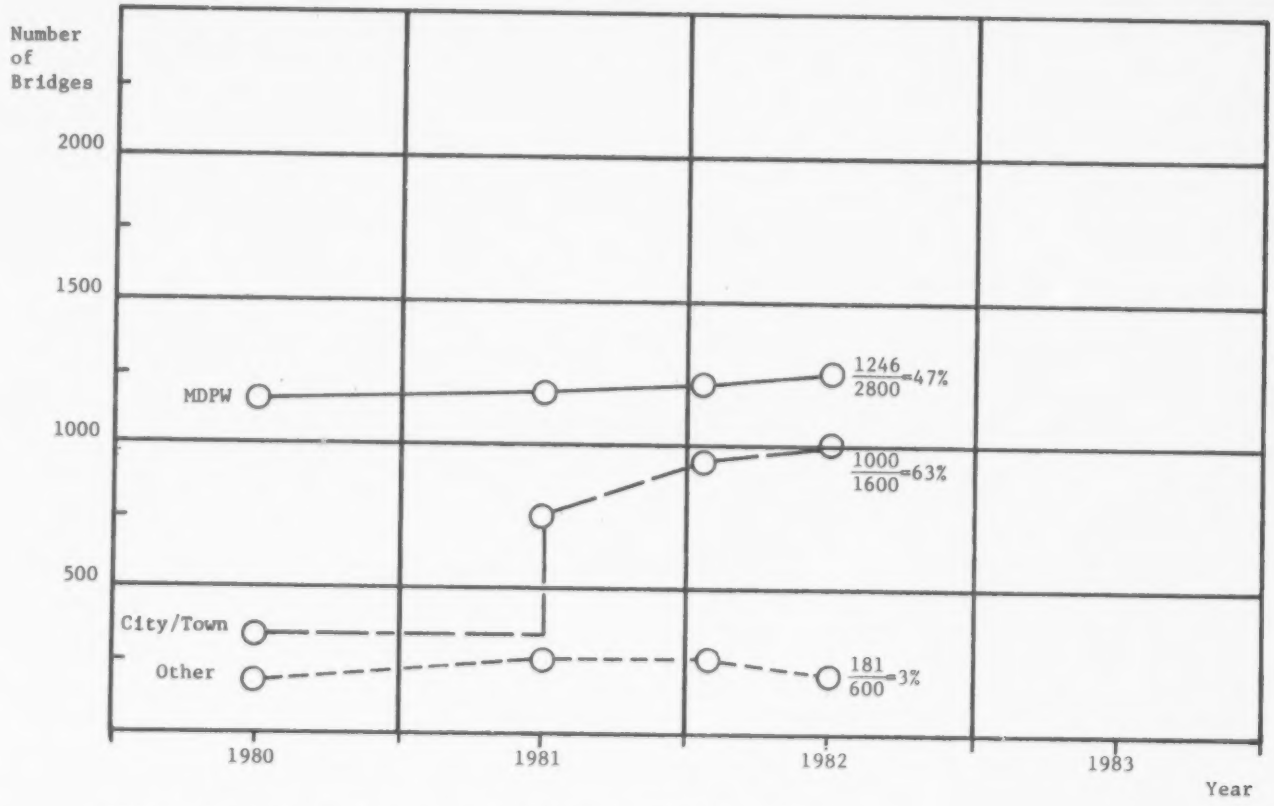
Table 3-18

AASHTO RATING OF MASSACHUSETTS BRIDGES

Owner	Rating <50	50-80	>80	Total
MDPW (%)	435	841	1524	2800
Municipal	496	504	600	1600
Other	20	161	419	600
Total	951 (20%)	1506 (30%)	2543 (50%)	5000 (100%)

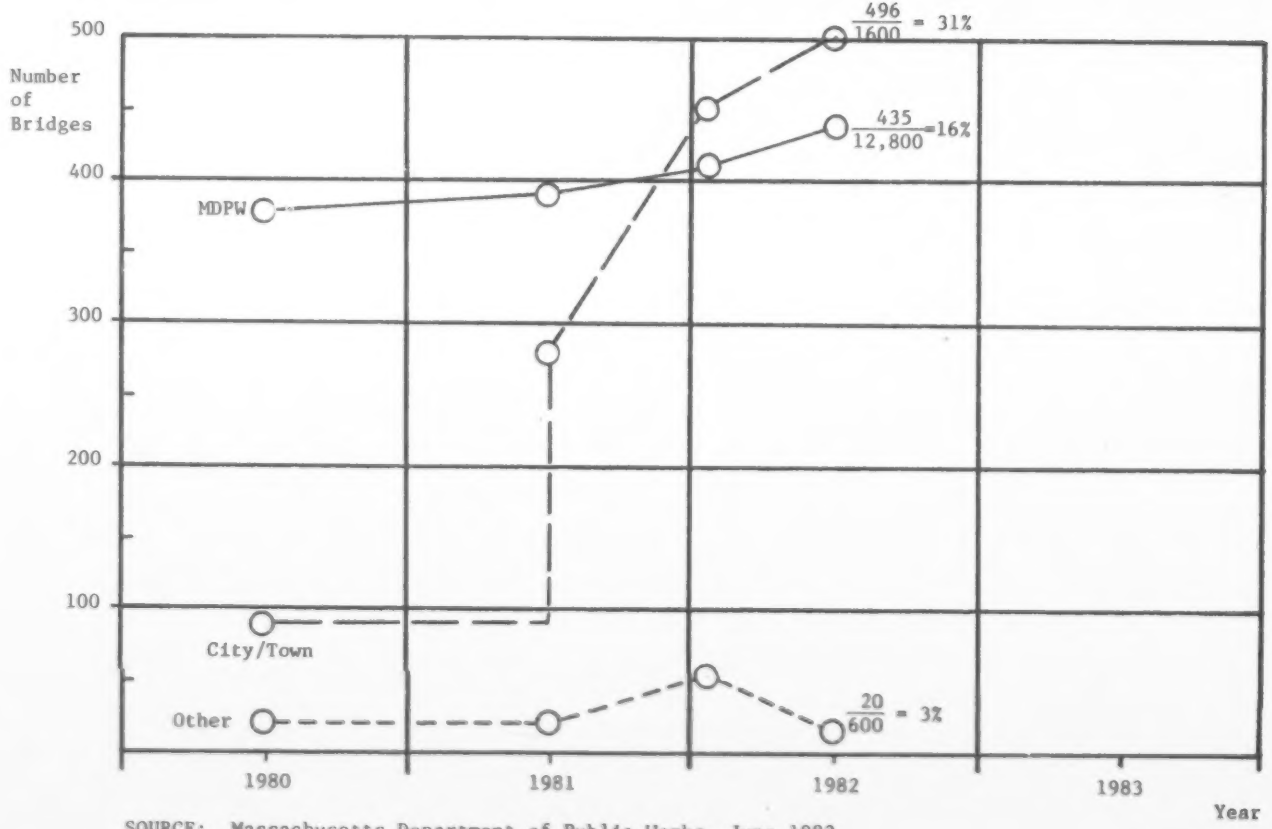
AASHTO = American Association of State Highway and Transportation Officials.
MDPW = Massachusetts Department of Public Works
Other = Massachusetts Turnpike Authority, Metropolitan District Commission, and Private.

SOURCE: Massachusetts Department of Public Works, 1980.



SOURCE: Massachusetts Department of Public Works, June 1982

Figure 3-4. AASHTO Sufficiency Rating < 80



SOURCE: Massachusetts Department of Public Works, June 1982

Figure 3-5. AASHTO Sufficiency Rating < 50

20-year bridge program would be about $25,000,000. Additionally, assuming a generous 100-year life for a typical highway bridge, the average annual cost of bridge replacement to maintain the status quo would be about $25,000,000. A program to maintain the status quo would require 50 bridge replacements each year.

According to the TRIP report (1982, p 3), the cost of bringing those 1,476 bridges which are in need of "preventive maintenance or substantial rehabilitation" up to state and federal standards will be on the average of $250,000 per bridge. The cost of bringing the 951 bridges that are in need of "immediate rehabilitation or replacement" up to state and federal standards will be on an average of $500,000 per bridge. Thus, the total cost of simply bringing the bridge system up to the condition required by state and federal standards would be about $844,500,000 (in 1982 dollars). The estimate does not include the engineering and design costs.

Construction Plans and Costs

There is no indication that there are any plans to construct new bridges on any new locations. All of the emphasis in the various published and unpublished sources is on the maintenance of the existing bridge facilities.

AIRPORTS

The Massachusetts Aeronautics Commission (MAC) is the statewide policy-making body for airport development that administers and enforces Massachusetts' aeronautic laws (MAC, Nov. 1980). It exercises all of the Commonwealth's responsibilty over all airports except Boston-Logan and Bedford-Hanscom, the latter two being managed by the Massachusetts Port Authority, a semi-independent state authority. The municipalities (cities,

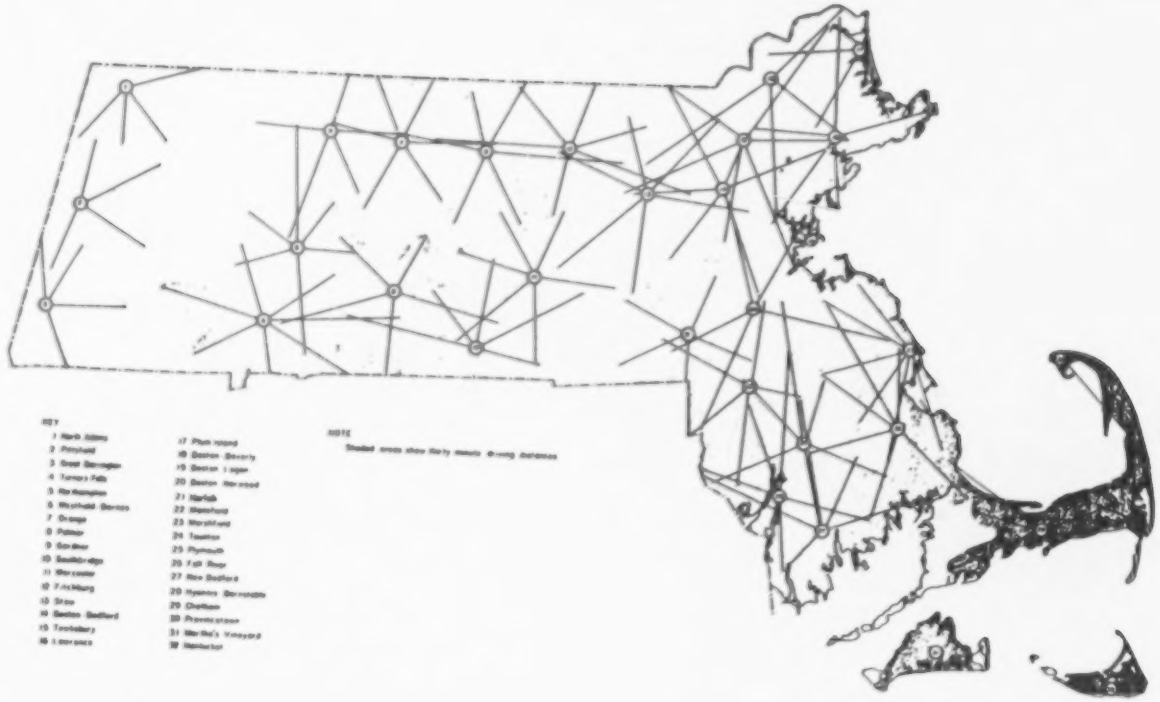
towns, and counties) may construct and operate airports and restricted landing areas provided they receive approval from the MAC. The official airport system of the state is divided into seven subregions. They include: Boston, Route 495, Cape and Islands, Hartford/Springfield, Route 2 Corridor, Southeastern Massachusetts, and Berkshires.

The airport network is constructed so that a pilot flying over the Commonwealth is always within 17 miles of a paved, lighted runway and no more than 24 miles from an airport with a published instrument approach (MAC, 1980, p.18). All major communities in the state have easy access to at least one general aviation airport. (Refer to Figures 3-6 and 3-7.) Scheduled passenger service is available at eight points: Pittsfield, Worcester, New Bedford, Hyannis, Martha's Vineyard, Nantucket, Provincetown, and Boston.

The current airport system has enough capacity to meet the state's airport demand until at least 1990 and perhaps the year 2000. In fact, according to the MAC, by 1990 airport capacity is expected to be 50 percent greater than demand. The surplus capacity will not, however, be evenly distributed over the system. For instance, Boston-Logan is currently experiencing a severe capacity shortage, while the Hartford/Springfield area is expected to have more than ample capacity through 1990. The distribution of capacity and demand will determine the needs of the existing airport facilities in terms of future maintenance and construction (MAC, 1980, p.24).

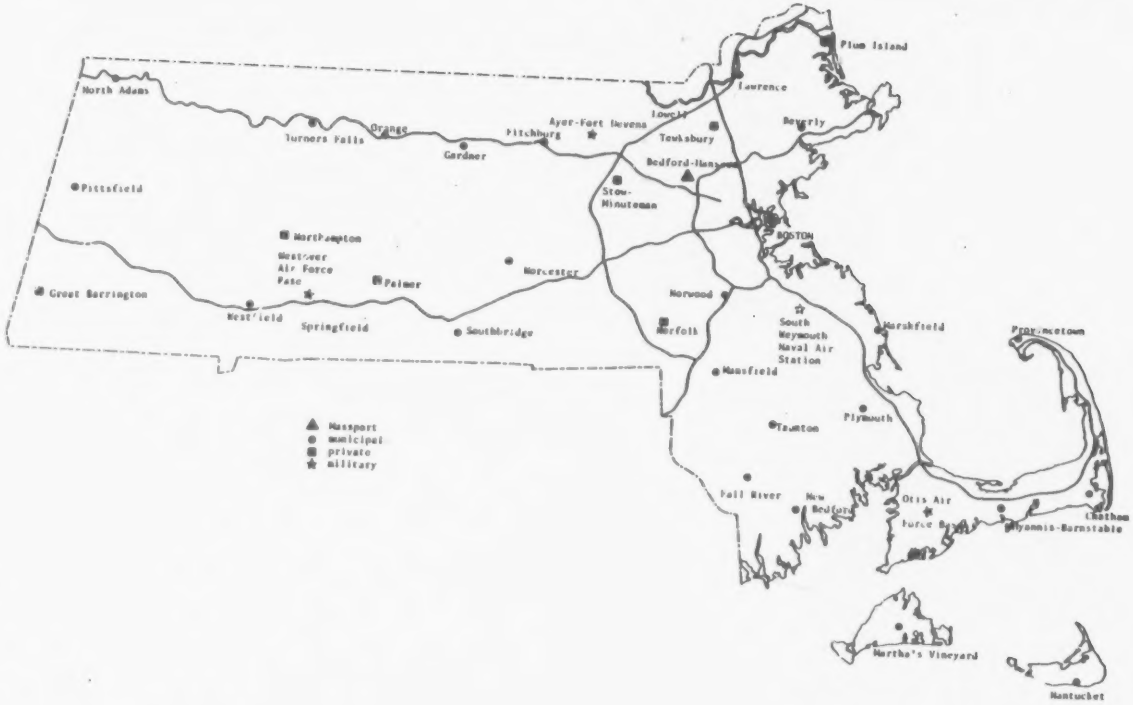
Facilities and Age

There are about 66 airport facilities in the state of Massachusetts. They include 47 airports, 6 grass fields, 6 heliports, 4 seaplane bases, and 2 military airports (MAC, Map, 1980). The airport facilities in the state are either municipally or privately owned. Most of the facilities are for general



SOURCE: Massachusetts Aeronautics Commission. Massachusetts Airport System Plan. November 1980

Figure 3-6. Airport Coverage in Massachusetts



SOURCE: Massachusetts Aeronautics Commission. Massachusetts Airport System Plan. November 1980

Figure 3-7. Massachusetts Essential Airport System

aviation and open for use by the public. There are about 160 facilities that are privately owned and not open to the public. Such facilities include, for instance, landing strips in the backyards of private homes. The newest general aviation airport was developed in 1947. Therefore, all the general aviation airports are at least 35 years old. Logan, the largest of the state's airports is 42 years old. (Prior to 1941, Logan was significantly smaller and was called the Boston Municipal Airport.)

Specific details on the existing facilities at each of the airports are not easy to find; however, some information is provided in Table 3-19. Most of the runways in the state are paved, but approximately 12 percent of the runways are sod (MAC, 1980, p.10). The runways range in length from 1,600 ft. at Falmouth to 10,000 ft. at Logan and average about 3,000 ft. Most of the runways are lighted, but about 25 percent of them are not (MAC, 1980, p.10). Sources such as the Massachusetts Aeronautics Commission, the Federal Aviation Administration, and the Aircraft Owners and Pilot's Manual may be helpful in finding more detailed information on the other airports in the state.

Logan airport is located on 2300 acres of land. There are five active runways, one of which is 2,500 ft., two of which are 7,900 ft., and two of which are 10,000 ft. The 10,000 ft. runways can accommodate any commercial airplane.

Maintenance Plans and Costs

The Massachusetts Aeronautics Commission is responsible for overseeing the upkeep of the municipally owned airport facilities (interviews, March 1983. Annual inspections are made by the Commission, and managers of the facilities are required to correct any deficiencies identified during those

TABLE 3-19

AIRPORT AND RUNWAY DESCRIPTION

NAME	RUNWAY	LENGTH	SURFACE	LIGHTING	FIELD ELEVATION
Agawam	5-23	2775	Paved	Yes	190
	10-28	2160	Paved	No	
Barre	6-24	3500	Paved	Yes	584
Bedford	11-29	7000	Paved	Yes	133
	5-23	5106	Paved	Yes	
Beverly	16-34	4637	Paved	Yes	108
	9-27	5000	Paved	Yes	
	2-20	3500	Paved	No	
Boston-Logan	4R-22L	10000	Paved	Yes	19
	4L-22R	7870	Paved	Yes	
	15R-33L	10000	Paved	Yes	
	15L-33R	2460	Paved	Yes	
	9-27	7002	Paved	Yes	
Chatham	6-24	3000	Paved	Yes	72
Edgartown	3-21	4000	Sod	No	20
	18-36	3000	Sod	No	
	6-24	2700	Sod	No	
	15-33	2200	Sod	No	
Fall River	6-24	3950	Paved	Yes	192
	15-33	1600	Paved	No	
Falmouth	7-25	2300	Paved	Yes	40
Fitchburg	14-32	4508	Paved	Yes	350
	2-20	3305	Paved	No	
Gardner	18-36	3000	Paved	Yes	955
Great Barrington	11-29	2700	Paved	Yes	726
Groton	17-35	2500	Sod	No	281
Hanson	18-36	1840	Paved	No	71
Haverhill	15-33	2040	Paved	No	115
Haverhill-Riverside	7-25	1610	Paved	No	20
Hopedale	18-36	3193	Paved	Yes	269
Hyannis	6-24	3567	Paved	Yes	56
	15-33	4000	Paved	Yes	
Lawrence	5-23	3000	Paved	Yes	155
	14-32	3900	Paved	Yes	
Mansfield	14-32	3500	Paved	Yes	124
	4-22	2100	Sod	No	
Marlboro	15-33	1650	Paved	No	285
Marshfield	6-24	3000	Paved	Yes	9

Table 3-19 (continued)

NAME	RUNWAY	LENGTH	SURFACE	LIGHTING	FIELD ELEVATION
Martha's Vineyard	6-24	5500	Paved	Yes	68
	1-19	3536	Paved	Yes	
	15-33	3300	Paved	Yes	
Middleboro	12-30	2850	Paved	Yes	61
Nantucket	6-24	6300	Paved	Yes	47
	15-33	4000	Paved	Yes	
New Bedford	5-23	5000	Paved	Yes	79
	14-32	5000	Paved	Yes	
Norfolk	18-36	2640	Paved	Yes	140
North Adams	11-29	4300	Paved	Yes	636
Northampton	14-32	3500	Paved	Yes	116
Norwood	17-35	4000	Paved	Yes	50
	10-28	4000	Paved	No	
Oak Bluffs	6-24	2200	Sod	No	40
	13-31	1900	Sod	No	
Orange	14-32	5000	Paved	Yes	555
	1-19	5000	Paved	No	
Oxford	2-20	2043	Paved	Yes	78
Palmer	--22	2570	Paved	Yes	480
Pepperell	6-24	2685	Paved	No	75
Pittsfield	8-26	5000	Paved	Yes	1170
	14-32	3500	Paved	Yes	
Plum Island	10-28	2340	Paved	Yes	15
	16-34	2200	Sod		
Plymouth	6-24	3500	Paved	Yes	149
	15-33	2500	Paved	Yes	
Provincetown	7-25	3500	Paved	Yes	12
Shirley	1-19	3600	Paved	Yes	410
Southbridge	2-20	3300	Paved	Yes	695
	9-27	1350	Sod	No	
Sterling	16-34	3090	Paved	Yes	450
Stow	3-21	2800	Paved	Yes	270
Taunton	12-30	3500	Paved	Yes	42
	4-22	2500	Sod	No	
Tewksbury	3-21	2900	Paved	Yes	90
	18-36	2600	Paved	No	
Turners Falls	16-34	3000	Paved	Yes	350
Westfield	2-20	9000	Paved	Yes	268
	15-33	4996	Paved	Yes	
Worcester	11-29	7000	Paved	Yes	1009
	15-33	5498	Paved	Yes	

SOURCE: Massachusetts Aeronautics Commission. Massachusetts Airport System Plan. November 1980.

inspections. The inspections include examination of runway pavement conditions, size and depth of runways, taxiways, and ramps. There are no fixed standards by which these evaluations are made. Each airport manager has a certain amount of time within which to correct the deficiencies. If they are not corrected within the time frame allotted, the Commission has the right to take away the facility's certificate of approval.

Officials at Massport indicate that the condition of the facilities at Logan is excellent, although it was reported that there are no formal standards by which the quality or condition of the airport facilities are measured. There are, however, regular internal and annual FAA inspections of the facilities.

Maintenance at all of the municipally owned airports and at most of the privately owned airports in the state are based upon annual inspections carried out by the Massachusetts Aeronautics Commission (interview, March 1983). Municipal airports are required by law to correct the deficiencies identified by the Commission inspectors. It is the responsibility of the airport managers to carry out the recommended maintenance. The Commission only has advisory power over the maintenance activity of privately owned facilities, although ultimately the Commission does have the right to revoke an airport's certificate of approval if it does not carry out recommended maintenance.

Logan airport operates a continuous preventive maintenance program. As a result, there is seldom any need to undertake specific structural maintenance or repair projects. As indicated above, internal inspections of the facilities, particularly the runways, take place regularly. The findings of these inspections vary from time to time and provide the basis for selection of the types of maintenance required (interview, March 1983).

The expected level of maintenance expenditure at Logan for the next five years is $55,000,000 (interview, March 1983).

Construction Plans and Costs

According to officials at the Massachusetts Aeronautics Commission, the types of construction expected to be carried out this year on the state's airports include major improvements such as apron, runway, taxiway, and internal road network rehabilitation (lighting and pavement), terminal expansion and renovation, obstruction clearing, and rebuilding of electrical vaults. Related projects include installation of localizer and marker beacons, master plan development, and environmental impact assessments. Table 3-20 provides specific details on airport construction plans and costs. Were the current federal share to be maintained, 90 percent of the expected cost would be financed by the Federal Aviation Administration.

SEAPORTS

There are many seaport facilities in the state of Massachusetts, however, data on stock, age, maintenance plans and costs, and construction plans and costs on existing facilities are disaggregated and difficult to obtain. For this reason, the seaport information in this report is confined to that of the ports of Boston, New Bedford, and Fall River. These are the largest publicly administered seaport facilities in the state of Massachusetts. In spite of their sizes and importance in the state's economy, information on the ports of New Bedford and Fall River is not as easily accessible as that for the port of Boston. The report reflects this difficulty.

Table 3-20

AIRPORT CONSTRUCTION PLANS AND COSTS (FY83)

Airports	Plans	Costs
Chatham	Apron and taxiway rehabilitation and explansion	$ 100,000
Curtis Falls	Feasibility study for runway expansion	Pending funding
Fall River	Rehabilitation of lights	Pending funding
Fitchburg	Fence installation	50,000
Hyannis	Runway rehabilitation	158,000
Lawrence	Runway and taxiway lighting; approach clearing; relocation of electricity vault	297,000
	Apron pavement and service road rehabilitation	450,000
Mansfield	Runway light rehabilitation	Pending funding
Marshfield	Runway reconstruction; land clearing (11 acres)	300,000
Nantucket	Main runway rehabilitation	1,000,000
	Master plan update	55,000
New Bedford	Feasibility study--obstruction clearing; terminal expansion; new taxiway lighting; runway approach improvements	55,000
Norwood	Main runway rehabilitation	1,920,000
Orange	Master plan update	45,000
Pittsfield	Master plan update	30,000
	Engineering work resulting from a recently completed pavement study	50,000
Plymouth	Localizer and marker beacon installation	200,000
	Master plan update	36,000
	Land clearing (10 acres)	100,000
Provincetown	Apron and taxiway reconstruction	153,000
Westfield	Pavement improvements; technical obstructions	2,100,000
Worcester	Main runway lighting; taxiway holding signs	100,000
	Tree clearing	73,000

Table 3-20 (continued)

AIRPORT CONSTRUCTION PLANS AND COSTS (FY 83)

Note: Future plans for Logan airport include development of a new air cargo/commercial complex and terminal improvements. The best guess as to what new capital may be needed at the airport by the year 2000 includes a new terminal, new runway, and improvements to the internal roadway system. The estimated costs of capital construction at Logan is (in 1980 dollars) $134,000,000 for the air cargo/commercial complex, $28,000,000 for the terminal improvements, roughly $100,000,000 for a new terminal, $40,000,000 to improve the internal road network, and $4,000,000 for a new runway (interview, March 1983).

SOURCE: Telephone interview with Massachusetts Aeronautic Commission, March 1983.

Facilities, Age, and Condition

The Port of Boston is a natural deep water harbor, with channels 40 ft. in depth (Massport, 1980, p.7). It houses a variety of modern terminal facilities, piers, berths, and shipyards, making it possible for it to accommodate today's most modern shipping vessels. There are about 130 piers, wharves, and docks, and three major public general cargo terminals--Conley, Moran, and Massport Marine. The Port of Boston is several centuries old; however, the Port, as it is known today, is the result of significant expansion and rehabilitation by the Massachusetts Port Authority after it was established in 1956 for the purpose of modernizing Boston's seaport facilities. The original port facilities conveyed to Massport in 1956 included the Hoosac Pier, Mystic Pier, East Boston Piers 1-5, Commonwealth Pier, and Conley Terminal. Of these original properties, only the Conley Terminal had the optimal physical criteria required for operation. The physical limitations of the other facilities led to the acquisition by Massport of land for the development of the Moran Terminal in the late 1960's and the leasing of land from the military at the former South Boston Naval Annex for the development of the Massport Marine Terminal, which is currently under construction.

The Conley Terminal is located on 101 acres of land and consists of 4,255 ft. of marginal wharf, one crane, one 220,000 ft. transit shed, and six berths (one of which was converted in 1972 to a container terminal consisting of one 1,100 ft. marginal wharf, two cranes, and ten acres of storage yard). (Massport, 1980, p.32)

The Moran Terminal, opened in 1971, is located on 40 acres of land and consists of one 1,100 ft. berth, two cranes, one transit shed, and twenty-two acres of storage space. It is operated in conjunction with a stuffing and

stripping shed at Mystic Pier 1, which is located on twelve acres of land and consists of one 900 ft. berth and transit shed. The Massport Marine Terminal is currently being redeveloped and is expected to comprise a 47-acre terminal with 2,700 ft. of marginal wharf, three berths, and four cranes. The terminal is being put into operation as capacity and demand expands (Massport, 1980, p.30).

In general, the Port of Boston is in good operating condition.

At the Fall River harbor, there are 17 piers, wharves, and decks. The State Pier was completed in 1955 at a cost of about $1.5 million. The Pier is a wooden-piling, wooden-deck fingered pier in good condition with narrow aprons. There is one berth, one terminal, and one transit shed extending the length of the Pier, and 2.5 acres of storage yard area. (In 1979, there were plans to acquire 2.5 more acres for storage area.) (Louis Berger and Associates, p.66)

The New Bedford Harbor is located on 20-25 acres of land. The State Pier at New Bedford is constructed of concrete on timber pile with a narrow apron on the lower side and four transit sheds made of concrete and steel. The terminal has an 18-ton fork lift for handling containers.

Maintenance Plans and Costs

Documented information on the maintenance of seaport facilities is not readily available. In general, however, maintenance includes dredging of ship channels into the ports, upkeep (such as paving repairs) of the surface infrastructure leading to the port facilities, upkeep (such as reroofing) of the terminals and storage sheds, repairs to fenders and piling of the wharves, and rebuilding of the berths.

These estimates reflect expectations of cost based upon past

experience at the Port of Boston. Repairs to piling and fenders of wharves are a major expense, approximately $2 million each decade. Reroofing is done as needed and averages about $3,000,000 per storage shed. Rebuilding berths costs about $2.5 million and must be done every 10-20 years (interview, March 1983).

Construction Plans and Costs

The Port of Boston recently embarked on an expansive development plan. Port development in the 1980's will focus on incremental expansion of container handling capacity at Conley Terminal in order to meet market demand and development of the Massport Marine Terminal complex in South Boston for bulk and break-bulk cargo (Massport, 1980, p.2).

In 1978, Massport began implementation of a three-phase development program. Phase 1, which was initiated in 1978, included the rehabilitation of Moran and Conley Terminals including replacement and addition of cargo handling equipment, rehabilitation of berths, storage areas, and terminal buildings, and expansion of container storage areas at Moran. Phase 2 involved the construction of a new ten-acre, two-crane container site at Conley Terminal completed in 1982. Phase 3 involves the creation of a new 47-acre (11 acres of land and 36 acres of water) marine terminal at the site of the former South Boston Naval Annex. It will be used in conjunction with the port properties at the Army Base, Commonwealth Flats, and the Naval Recreation site. It is expected to accommodate demand for port facilities in Boston through the year 2000. It will serve as a break-bulk facility and can be converted for use in handling containers as market demand expands. The first stage of Phase 3 includes the construction of a dike, 36 acres of landfill and rehabilitation of existing berth and land area. The Maritime

Capital Program for 1983-84 continues implementation of the Phase 3 of the development Program. There are four major areas of activity: (1) rehabilitation of Conley terminal infrastructure unrelated to the development of new container capacity; projects include Shed 1 repairs, roadway construction, berth rehabilitation, and water main replacement. (2) basic maintenance as required to keep the terminals in reasonable operating condition; (3) continued development of Massport Marine Terminal to allow transfer of cargo from Conley and handling of other break-bulk and bulk vessels; projects include dredging, jetty repairs, construction of interior dikes, replacement of drain lines, and land filling as material becomes available; (4) development of facilities to meet demand of new cargos and tenants.

At Fall River, an Economic Development Administration (EDA) grant was awarded in 1979 for upgrading and expansion of the State Pier. This was a two-phase development program. Phase 1 involved the filling of Crab Pond and development of 7.5 new acres. Phase 2 involved the rehabilitation and reconstruction of an existing seawall to provide docking spaces for barges and other commercial vehicles.

Neither the Department of Environmental Quality Engineering nor the Fall River Line Pier (which own and manage the State Pier, respectively) have any planning staff for the development of the Fall River State Pier. Any plans, such as those funded by the EDA grant, are initiated at the local level. There are no comprehensive Master Plans identifying a long-run direction for the development for Fall River port facilities.

There are no recent development plans for the New Bedford port facilities.

For the Port of Boston, the estimated cost of Phase 3 of the

development program is $23 million for construction of the dike and the filling of 36 acres of water. (The costs of Phases 1 and 2 were $17 million and $19 million, respectively.) An additional $21 million is included in the FY1983-84 Capital Program for Phase 3. Of this amount, $9.6 million worth of projects are already underway. An additional $4.5 million has been set aside for expansion of container facilities at Conley if justified by market demand. Also, $3.7 million has been set aside for other terminal rehabilitation and access improvements.

No estimates were available for Fall River plans.

An important issue with regard to maintenance and construction of seaport facilities in Massachusetts is the fact that the demand for usage of port facilities appears to be growing very slowly, or, in some cases, not at all. The uncertainty about the future growth of demand makes it very difficult to estimate what will be required in the way of new facilities and maintenance to the year 2000.

HIGHWAYS

Jurisdiction over the state's roadway system is divided between the Massachusetts Department of Public Works (MDPW), the Massachusetts Turnpike Authority (MTA), the Metropolitan District Commission (MDC), and 351 cities and towns. The Interstate routes, established by Congress, are managed by the MDPW and MTA. All other major highways are administered by the MDPW, MDC, and the cities and towns.

There are two funding systems, the federal-aid system and the state-aid system. The federal-aid system includes interstate, primary, secondary, and urban routes administered by the MDPW and MDC. The state-aid system includes primary and local routes administered by the cities and towns.

Facilities and Age

As shown in Table 3-21, there are about 33,780 linear miles of roadway in the state of Massachusetts (Byrd, Tallamy, 1982, p.8). They are divided among the following functional classifications:

Interstate highways	529.66
Rural principle arterials and their urban extensions	756.37
Rural minor arterials and their urban extensions	1471.71
Other urban principle arterials with beginning and ending terminus in a single urban area	918.64
Rural major collectors and urban minor arterials	4407.38
Rural minor collectors and urban minor arterials	4680.85
Local roads and streets	21007.01

Local roads and streets account for about 60 percent of the state's roadway system. However, most of the daily vehicular miles traveled in the state occurs on a very small percentage of the system. The parts of the system administered by the MDPW, the MTA, and the MDC account for only 10 percent of the roadway system, but 50 percent of the daily vehicular miles traveled on the system. The mileage by funding system is shown in Table 3-22, and the funding systems are given in Table 3-23. A jurisdictional comparison is provided in Table 3-24, and the daily miles traveled are given in Table 3-25.

Measurement of the condition of the roadway system is not an easy process. The primary source of difficulty is the lack of consistency between local, state, and federal standards. This makes a general assessment of the condition or the quality of the state's roadway system almost impossible in the short run. Officials at the MDPW indicate that it would take a lot of time and energy to generate accurate, consistent, and up-to-date assessments of the state's roadway system.

According to The Road Information Program (TRIP) report written in 1982, an estimated 21,759 miles (65 percent) of the system are in good to fair condition. These estimates are based on standards established by the American

TABLE 3-21 EXISTING SYSTEM MILEAGE BY FUNCTIONAL CLASSIFICATION

FUNCTIONAL CLASSIFICATION	JURISDICTION					TOTAL	PERCENT-AGE
	STATE	LOCAL	MDC	MTA	OTHER		
1	382.0	0	0	134.5	0	516.5	1.5%
2	614.1	98.5	37.9	5.7	2.1	758.3	2.2%
3	882.0	586.2	0.2	1.1	0.4	1,469.9	4.4%
4	182.9	710.2	22.6	0	3.3	919.0	2.7%
5	638.2	3,698.9	52.6	0.2	14.2	4,404.1	13.0%
6	66.9	4,593.2	11.6	0	10.6	4,682.3	13.9%
0	77.0	20,396.2	123.1	0.1	430.9	21,027.3	62.3%
TOTAL	2,843.1	30,083.2	248.0	141.6	461.5	33,777.4	100%
PERCENTAGE	8.4%	89.1%	0.7%	0.4%	1.4%	100%	

TABLE 3-22 EXISTING MILEAGE BY FUNDING SYSTEM

FEDERAL-AID SYSTEM	JURISDICTION					TOTAL	PERCENT OF TOTAL
	STATE	LOCAL	MDC	MTA	OTHER		
INTERSTATE	382.0	0	0	134.5	0	516.5	
PRIMARY	1,496.1	684.7	38.1	6.8	2.5	2,228.2	
SECONDARY	394.7	1,706.5	0	0	10.6	2,111.8	
URBAN	452.7	5,097.2	80.8	0.2	10.2	5,641.1	
TOTAL F-A	2,725.5	7,488.4	118.9	141.5	23.3	10,497.6	31.1%
PERCENT OF F-A	26.0%	71.3%	1.1%	1.4%	0.2%	100%	0
NON/F-A	117.6	22,594.8	129.1	0.1	438.2	23,279.8	68.8%
TOTAL	2,843.1	30,083.2	248.0	141.6	461.5	33,777.4	100%

TABLE 3-23

FUNDING SYSTEMS

FUNCTIONAL CLASSIFICATION	FEDERAL-AID	STATE-AID *	NUMBERING SYSTEMS
1	INTERSTATE	N/A	INTERSTATE
2	PRIMARY	PRIMARY	US AND STATE
3	PRIMARY	PRIMARY	US AND STATE
4	URBAN	PRIMARY	STATE AND UN-NUMBERED
5	SECONDARY AND URBAN	PRIMARY	STATE AND UN-NUMBERED
6	URBAN AND NON-FA	PRIMARY	UN-NUMBERED
0	NON-FA	LOCAL	UN-NUMBERED

* THE STATE-AID SYSTEM APPLIES ONLY TO THOSE ROADS UNDER JURISDICTION OF CITIES AND TOWNS.

MASSACHUSETTS
FUNCTIONAL CLASSIFICATION

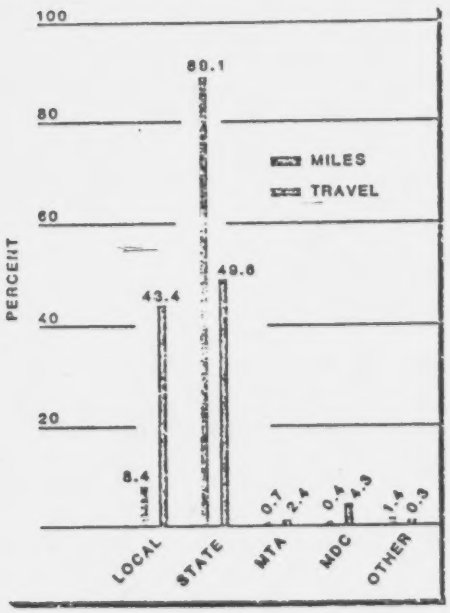
Code	Description
1	Interstate highways
2	Rural principal arterials and their urban extensions. These are routes of both intra and interstate importance which link population centers of at least 25,000.
3	Rural minor arterials and their urban extensions. These are routes of regional importance that link population centers of 5,000 and more.
4	Other urban principal arterials, with beginning and ending terminals within a single urban area.
5	Rural major collectors and urban minor artierals.
6	Rural minor collectors and urban collector streets.
0	Local roads and streets.

SOURCE: Byrd, Tallamy, MacDonald, and Lewis. 1982. A Report to the Massachusetts Special Commission on Highways. Virginia (April).

TABLE 3-24 JURISDICTIONAL COMPARISON

JURISDICTION	LINEAR MILES	LANE MILES	TRAFFIC (VMT IN 1,000's)
STATE (DPW)	2,843.1 (8.4%)	8,392.6 (12.7%)	41,946 (43.4%)
LOCAL (INCLUDES UNACCEPTED)	30,083.2 (89.1%)	56,799.8 (84.3%)	48,000 (49.8%)
MDC	248.0 (0.7%)	553.0 (0.9%)	2,286 (2.4%)
MTA	141.6 (0.4%)	670.0 (1.0%)	4,151 (4.3%)
ALL OTHERS	461.5 (1.4%)	744.1 (1.1%)	308 (0.3%)
TOTAL	33,777.4 (100%)	66,159.5 (100%)	96,691 (100%)

TABLE 3-25 ROAD MILES AND DAILY VEHICLE MILES TRAVELED



STATE JURISDICTION:

DPW	2,843.1
MDC	248.0
MTA	141.6
PARKS	286.8
INSTITUTIONS	9.7
COLLEGES	16.7
PORT	3.0
TOTAL	3,678.8 MILES

LOCAL JURISDICTION:

CITIES AND TOWNS	26,1222.7
UNACCEPTED	3,860.5
TOTAL	30,083.2 MILES

FEDERAL JURISDICTION:

PARKS	28.4
DEPT OF DEFENSE	86.9
CORPS OF ENGR	2.8
INSTITUTIONS	1.6
TOTAL	118.4 MILES

SOURCE: Byrd, Tallamy, MacDonald, and Lewis. 1982. A Report to the Massachusetts Special Commission on Highways. Virginia (April).

Association of State Highway and Transportation Officials (AASHTO). These roads are characterized by "extensively cracked, rutted, and broken pavement" and require resurfacing or replacement (TRIP Report, 1982, p.2).

A second data source on road conditions, available at the MDPW, was completed in 1981 and pertained only to the parts of the system receiving Federal aid. The parts of the system receiving Federal aid account for only about 33 percent of the total system (Byrd, Tallamy, 1982). According to these data, 5,004 miles (39 percent) are in good condition, with no indication of failure; 6,806 miles (53 percent) are in fair condition, showing minor evidence of cracks and patching, but not yet affecting serviceablity; 916 miles (7 percent) are in deficient condition, showing evidence of cracking, rutting, potholes, and extensive joint failure; and 32 miles (2 percent) are intolerable and in complete disrepair.

The MDPW is currently in the process of completing a broader assessment of the state's public road system (interview, March 1983). There is a Highway Performance Maintenance System through which each state is mandated to submit to the Federal Highway Administration (FHWA) detailed information, including condition, on the Federal aid part of its roadway system. In order to carry out the mandate of the FHWA, the MDPW has selected a stratified random sample of 2,200 links in the highway system upon which extensive tests of road condition are to be executed. Thus, far the MDPW has been able to complete the tests on only 350 of the 2,200 sections. Severe cutbacks in their staff have prohibited more timely completion of the task. It is expected, however, that the evaluations will be completed by the end of 1983.

The Massachusetts Turnpike Authority (MTA) indicates that there is an annual inspection of the Turnpike facilities and that the Turnpike is in good

repair (interview, March 1983).

One factor that will certainly effect the rate at which the road system deteriorates in the future is the new Surface Transportation Act Legislation (interview, March 1983). In this new legislation, there has been an upward adjustment of the length and weight of trucks on the roads. This will, no doubt, increase the wear and tear on the state's major roads. Officials at the MDPW indicate that it is unlikely that the new revenues to be generated from the increased gasoline tax and truck registration fees will cover the higher costs of maintaining the road system as truck weights and lengths increase.

The age of the roadway system as a whole would be extremely difficult to determine. The initial part of the Turnpike (New York to Route 128) opened in May 1957. The Boston extension (Route 128 to Kneeland St.) opened in 1965-1966.

Maintenance Plans and Costs

Maintenance of the roadway system generally consists of resurfacing (every 10 years), repainting safety lines, guardrail replacement, and snow and ice removal. Specific maintenance plans for all of the state's roads are difficult to find. There are many administrative bodies overseeing the maintenance of the system, hence the information is very fragmented. (The types of maintenance mentio..ed above are the types of maintenance carried out by the MDPW.) (interview, March 1983)

The MDPW is one of the many administrative bodies responsible for maintaining the roadway system. In its FY1983 budget, the apportionment for highway and bridge maintenance was $4,504,520; for snow and ice removal, $7,350,000; for repainting of safety lines, $650,000; and for materials and

supplies, $2,380,000. Officials at the MDPW indicated that there is a severe shortage of funds for maintenance activity and that maintenance needs far surpass available resources. The shortage has forced the Department to become fairly innovative in the preservation and acquisition of maintenance equipment. For instance, snow-fighter trucks with well-preserved engines have been rehabilitated at a cost of $52,000; the cost of a new snow fighter is about $105,000. The MDPW staff has also purchased surplus army equipment, often saving 50% of the cost of new equipment (interview, March 1983).

Construction Plans and Costs

At the MDPW, future investment plans are difficult to predict beyond 6 months to 1 year (interview, March 1983). The major factors contributing to the uncertainty include a recent change of gubernatorial administrations, the political ramifications of any plans, and the uncertainty regarding the availablity of federal funds. In general, plans for construction will be dictated by the level of federal funds made available, and the investment priorities of Congress. The Department is currently assembling a list of projects to be carried out in FY1984. Last year $200 million worth of new capital investment projects were advertised.

The MTA anticipates no new construction. Because there are no definitive construction plans, there is no information on construction costs.

TUNNELS

The two major tunnels in Massachusetts, Callahan and Sumner, which provide linkage between Logan airport and the city of Boston, are administered by the MTA. Each tunnel is about 1 mile long. The Callahan Tunnel, built in 1961, is about 22 years old. It is in good working condition. Maintenance of the Tunnel generally consists of washing the walls, repainting the safety

lines, replacing the lights, and improving the drainage above and below the tunnel. The road is resurfaced as needed, which is relatively less frequently than other roads because of light usage and less exposure to adverse weather conditions. The Sumner Tunnel, built in 1934, is about 50 years old and is currently being rehabilitated. The rehabilitation project includes repainting, road patching, and the scraping and replacement of tile.

There is a proposal to extend Interstate Route 90 (Massachusetts Turnpike) from its present terminus in Boston at the Central Artery across the Boston Harbor to a new terminus in East Boston. The new tunnel, the Third Harbor Crossing, would increase harbor highway capacity thus supplementing the capacity of the Sumner and Callahan Tunnels and the Mystic-Tobin Bridge. It would be a four-lane, limited-access highway, and would include a depressed Central Artery, increasing capacity one lane in each direction. The new tunnel would provide direct access to the Mass Turnpike, Boston's Central Artery, and Logan Airport.

SUMMARY

The current and expected revenues and expenditures on transportation infrastructure are presented in Table 3-26. No information was readily available for some of the modes of transportation. Therefore, the overall gap between expected revenues and expenditures could not be determined. The available figures indicate that for highways, bridges, tunnels, railways, and the MBTA as a group, anticipated revenues to the year 2000 may either exceed anticipated expenditures by approximately $200 million, or they may fall short by as much as $3,940 million. A more detailed discussion of these estimates is provided in Part 6.

The environmental infrastructure is discussed in the next two sections of this report.

Table 3-26

SUMMARY OF CAPITAL INVESTMENT NEEDS AND REVENUES IN MASSACHUSETTS--TRANSPORTATION
(millions of 1982 dollars)

Investment	Needs for Selected Periods: Period	Needs for Selected Periods: Total Need	Average Annual Need	Need to Year 2000	Average Annual Expenditures[o]	Total Expected Revenue to Year 2000[p]: Total	Federal	State	Local	Expected Revenue Minus Expected Need to Year 2000
Highways, Bridges, and Tunnels										
Highways	1983	300[a]	250-350	5,400						
Bridges	1980-2000	1,000[b]	50	900	100	9,458-9,818	5,858[q]	3,600-3,960	n.a.	2,158-2,518
Tunnels	--	1,000[b]	--	1,000			[3,339][r]			
Railways	1983-1987	220[c]	43	780	9	162	n.a.	n.a.	n.a.	(518)
Public Transportation										
MBTA	1983-1987 (1993)[d]	1,400-1,600	150-400	2,700-7,200	70	1,260	n.a.	n.a.	n.a.	(1,440)-(5,940)
Other	1983-1988	28[e]	5-6	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Airports[f]										
Logan	1983-1988	550[g]	110	2,300	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other	1983-1984	12[h]	5	90	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Seaports[n]										
Boston		[i,n]								
Other										

SOURCE: Refer to Table 6-1.

Figures in ( ) are negative.

Part 4

ENVIRONMENTAL INFRASTRUCTURE--WATER

Information on environmental infrastructure was obtained for water, sewerage systems, and hazardous waste.

WATER

As one of the oldest states in the Union, and indeed one of the areas of the country first settled by Europeans in the 17th century, the problems of Massachusetts' water infrastructure are those of a mature system where the most easily tapped sources of water have long been utilized, and the water distribution system is old and in need of repair.

The two major components of Massachusetts' water infrastructure are water supply and water distribution, to provide potable drinking water to communities while controlling water pollution through adequate sewage treatment. Questions of water quality are intrinsically related to the sewerage infrastructure, especially in terms of controlling water pollution due to sewerage problems.

Issues associated with supplying fresh water to major urban areas typically focus on water supply rather than on water distribution. Distribution networks are largely fixed by public safety (fire) requirements on the lower end and by a relatively fixed central business/high density demand pattern on the upper end. The critical issues of water supply today and in the future are those associated both with the number of inhabitants and the location and adequacy of supply to serve the projected population. (Refer to Table 4-1.)

The three basic questions to consider in the area of water are those of quality, quantity, and cost: is enough water of acceptable quality available to the state's residents? These issues provide a

Table 4-1

Population and Water Supply for Communities of 10,000 or more, 1982

Municipality[1]	1980 Population	Percent Change, 1970-1980	1982 Safe Yield In MGD	Gallons Per Capita Per Day
Acton town[2]	17,544	18.8	2.7	153.9
Adams town[2]	10,381	-11.8	8.40	809.2
Agawam town[3]	26,271	21.0	--	76.1
Amesbury town[2]	13,971	22.7	1.75	125.3
Amherst town[2]	33,229	26.2	5.94	178.8
Andover town[2]	26,370	11.3	12.00	455.1
Arlington town[4]	48,219	-9.9	4.76	98.7
Athol town[2]	10,634	-4.9	1.74	163.6
Attleboro city[2]	34,196	3.9	8.75	255.9
Auburn town[5]	14,845	-3.3	2.5	168.4
Barnstable town[2]	30,898	55.7	20.72[5]	531.6
Bedford town[6]	13,067	-3.3	0.68	52.4
Bellingham town	14,300	2.4	2.24	156.6
Belmont town[4,7]	26,100	-7.7	3.02	115.7
Beverly city[2]	37,655	-1.8	13.4	176.6
Billerica town[4]	36,727	16.0	7.00	190.6
Boston city[2]	562,994	-12.2	135.24	240.2
Bourne town[8]	13,874	9.8	5.49	395.7
Braintree town	36,377	3.7	8.00	105.6
Bridgewater town	17,202	45.4	1.49	86.6
Brockton city[2,6]	95,172	6.9	9.50	99.8
Brookline town[4]	55,062	-6.5	7.15	129.9
Burlington town[2]	23,486	6.9	5.80	247.0
Cambridge city[9]	95,322	-5.0	17.67	185.4
Canton town[2,4]	18,182	6.3	5.05	277.7
Chelmsford town	31,174	-0.8	7.04	225.8
Chelsea city[4]	25,431	-17.0	3.38	132.9
Chicopee city[4]	55,112	-17.3	10.42	189.1
Clinton town[4]	12,771	-4.6	1.93	151.1
Concord town[2]	16,293	0.9	4.5	276.2
Danvers town[6]	24,100	-7.8	3.33	138.2
Dartmouth town[6]	23,966	27.5	6.20	258.7
Dedham town[10]	25,298	-6.1	5.00	129.8
Dennis town[6]	12,360	91.5	7.3	590.6
Dracut town	21,249	16.7	3.18	149.6
Duxbury town	11,807	54.6	3.01	254.9
Easthampton town[2]	15,580	19.7	6.5	417.2

Table 4-1, page 2

East Longmeadow town[3]	12,905	-1.0	--	--
Easton town[2,4]	16,623	36.7	2.70	162.4
Everett city[4]	37,195	-12.5	8.47	227.7
Fairhaven town[6]	15,759	-3.5	2.00	126.9
Fall River city[2]	92,574	-4.5	16.00	172.8
Falmouth town[2]	23,640	48.3	15.1	638.7
Fitchburg city[2]	39,580	-8.7	10.55	266.5
Foxborough town[4]	14,148	-0.5	3.00	212.0
Framingham town[4]	65,113	1.7	10.94	168.0
Franklin town	18,217	2.2	3.53	193.8
Gardner city	17,900	-9.4	1.78	99.4
Gloucester city	27,768	-0.6	3.5	126.0
Grafton town	11,238	-3.6	2.25	200.2
Greenfield town[2]	18,436	1.8	3.3	179.0
Hanover town	11,358	12.4	3.23[4,11]	284.4
Harvard town	12,170	-9.4	4.41[4,11]	362.4
Haverhill city[2]	46,865	1.6	8.70	185.6
Hingham town[2]	20,339	7.9	9.33	458.7
Holbrook town[8]	11,140	-5.4	8.00	105.6
Holden town[3]	13,336	6.1	2.03	152.2
Holliston town	12,622	4.6	2.47	195.7
Holyoke city[2]	44,678	-10.8	15.74[9]	352.3
Hudson town	16,408	2.0	1.87[9]	114.0
Ipswich town	11,158	3.8	1.90	170.3
Lawrence city	63,175	-5.6	14.0	221.6
Leominster city[2,4]	34,508	4.8	17.40	504.2
Lexington town[2,4]	29,479	-7.5	5.8	196.7
Longmeadow town[3]	16,301	4.3		
Lowell city[2]	92,418	-1.9	14.6	158.0
Ludlow town[3]	18,150	3.2	5.60	308.5
Lynn city[4]	78,471	-13.1	14.53	185.2
Lynnfield town[4]	11,267	4.1	1.37	121.6
Malden city[4]	53,386	-4.9	5.43	101.7
Mansfield town[2]	13,453	35.4	4.82	358.3
Marblehead town[4]	20,126	-5.5	2.16	107.3
Marlborough city[2,4]	30,617	9.6	4.28	139.8
Marshfield town[2]	20,916	37.4	4.9	234.3
Medfield town	10,220	4.1	2.88	281.8
Medford city[4]	58,076	-9.8	8.98	154.8
Melrose city[4]	30,055	-9.4	2.81	93.5
Methuen town[6]	36,701	3.5	3.17	86.4
Middleborough town	16,404	20.6	2.12	129.2
Milford town[2]	23,390	20.9	3.00	128.3
Millbury town[4]	11,808	-1.5	3.15	266.8
Milton town[2,4]	25,860	-4.9	2.98	115.2
Natick town[4]	29,461	-5.1	7.5	254.6
Needham town[4]	27,901	-6.2	3.58	128.3
New Bedford city[2]	98,478	-3.2	27.5	279.3
Newburyport city[2]	15,900	0.6	2.29	144.0

Table 4-1, page 3

Newton city[4]	83,622	-8.2	11.11	132.9
North Adams city[2]	18,063	-5.9	9.25	512.1
Northampton city	29,286	-1.3	10.00	341.5
North Andover town	20,129	23.6	4.50	223.6
North Attleborough town	21,095	13.0	5.00[9]	237.0
Northborough town	10,568	14.6	2.40	227.1
Northbridge town[2]	12,246	3.8	4.65	379.7
North Reading town[6]	11,455	1.7	1.50	130.9
Norton town	12,690	33.8	2.10	165.5
Norwood town[4]	29,711	-3.6	4.35	146.4
Oxford town	11,680	12.9	2.00	171.2
Palmer town	11,389	-2.5	2.18	191.4
Peabody city[4]	45,976	-4.4	6.49	141.2
Pembroke town[6]	13,487	20.5	1.78	132.0
Pittsfield city[2]	51,974	-8.8	14.7	282.8
Plymouth town	35,913	93.0	11.0	306.3
Quincy city[4]	84,743	-3.7	11.72	138.3
Randolph town[8]	28,218	4.4	8.00	105.6
Reading town	22,678	0.6	7.7	339.5
Revere city[4]	42,423	-1.7	4.64	109.3
Rockland town[2]	15,695	0.1	2.50	159.3
Salem City[7]	38,220	-5.8	13.4	176.6
Saugus town[4]	24,746	-1.4	3.78	152.8
Scituate town	17,317	2.0	2.54	146.7
Seekonk town	12,269	10.4	3.1	252.7
Sharon town[2]	13,601	10.0	2.95	216.9
Shrewsbury town[5]	22,674	18.1	4.18	184.4
Somerset town[2,6]	18,813	4.0	4.78	254.1
Somerville city[4]	77,372	-12.8	9.80	126.7
Southbridge town	16,665	-2.3	2.90	174.0
South Hadley town[2,4]	16,399	-3.7	3.84	234.2
Spencer town	10,774	22.7	1.30	120.7
Springfield city[2]	152,319	-7.1	65.00	426.7
Stoneham town[4]	21,424	3.4	3.58	167.1
Stoughton town[8]	26,710	13.9	3.57	133.7
Sudbury town	14,027	3.9	3.86	275.2
Swampscott town[4]	13,837	1.9	1.97	142.4
Swansea town	15,461	22.3	2.84	183.7
Taunton city[2,6]	45,001	2.8	12.5	277.8
Tewksbury town[6]	24,635	8.3	4.6	186.7
Wakefield town[4]	24,895	-2.0	2.30	92.4
Walpole town	18,859	3.9	3.6	190.9
Waltham city[4]	58,200	-5.5	11.50	197.6
Wareham town	18,457	60.6	4.4	238.4
Watertown town[4]	34,384	-12.5	4.72	137.3
Wayland town	12,170	-9.6	4.10	336.9
Webster town	14,480	-2.9	2.50	172.7
Wellesley town	27,209	-3.0	5.20	191.1

Table 4-1, page 4

Westborough town	13,619	8.1	2.78	204.1
Westfield city	36,465	16.0	16.5	452.5
Westford town[4]	13,434	29.6	2.8	208.4
Weston town[12]	11,169	2.8	1.15	103.0
Westport town	13,763	40.6	--	--
West Springfield town	27,042	-5.0	6.5	240.4
Westwood town[10]	13,212	3.6	5.00	129.8
Weymouth town	55,601	1.8	11.30	203.2
Whitman town[6]	13,534	3.6	.74	54.7
Wilbraham town[2,4]	12,053	0.6	0.85	70.5
Wilmington town[2]	17,471	2.2	4.1	234.7
Winchester town[4]	20,701	-7.0	3.73	180.2
Winthrop town[4]	19,294	-5.1	2.08	107.8
Woburn city[4,6]	36,626	-2.1	5.55	151.5
Worcester city[2,6]	161,799	-8.4	29.00	179.2
Yarmouth town	18,449	53.3	7.7	417.4

Source: U.S. Bureau of the Census. 1982. 1980 Census, Table 14. Massachusetts Water Resources Commission, 1982.

1 Places of 10,000 or more only
2 Supplies water to other towns
3 Water supply is from Springfield Municipal Water Supply
4 Member or client of Metropolitan District Commission Water District
5 Also draws from Worcester Water Department
6 Also draws on water supplies from other towns or cities
7 Beverly and Salem have combined water supply; per capita safe yield is for both towns combined.
8 Braintree, Holbrook and Randolph have a combined water supply; per capita safe yield is for all three towns combined.
9 MDC augments supply on as-needed basis
10 Westwood and Dedham have combined water supply; per capita safe yield is for both towns combined.
11 Includes 4.35 mgd from Ford Devens.
12 Not on central supply

framework for assessing the adequacy of Massachusetts' water infrastructure by asking if that infrastructure furnishes the state with sufficient clean, safe water at a reasonable cost.

In this part of the report, the question of the infrastructure with respect to water is separated into the areas of water supply, water distribution, and cost/funding considerations. Information on meters, hydrants, standpipes, and storage towers, although part of the water distribution system, was not provided by most sources, and is therefore included in this analysis only when available. Questions of water quality will be discussed below in the section on sewerage infrastructure.

The question of water supply has long been a statewide problem, involving hundreds of pieces of legislation authorizing transfers of water between jurisdictions since the 19th century. However, widespread awareness that water supply is a common problem has only occurred more recently. The decentralized nature of the water-distribution system, with each town and city financing and building its own water distribution system, has prevented a similar perception of commonality of need to maintain that infrastructure until recently. It is only since 1979 that the state has had any program of involvement with local distribution systems (Massachusetts Legislature, Chapters 805 of the Acts of 1979 and Chapter 286 of the Acts of 1982, discussed below).

Proposals to remedy potable water problems in the state take several forms: increasing supply, improving quality, and reducing losses from leakage and waste. For problems related to the adequacy and quality of the state's water supply, a Massachusetts Water Supply Policy Statement (Wallace, Floyd, Ellenzweig and Moore Inc., 1978) emphasizes

the protection and conservation of the water resources of the state. Others (Massachusetts Special Legislative Commission, 1977) have focused on improving the water delivery system to reduce water loss through leakage. If Table 4-2 is at all accurate, most towns have ample supplies of water. Shortages are therefore most probably due to a combination of especially dry conditions, poor planning, loss of potable water during transmission from source to delivery, or excessive consumption (i.e., waste).

In this section of the report, a summary is provided on the problems of water supply in the Commonwealth, on some proposals to remedy water shortages of recent years, and on some of the financial questions. Issues involving water sources are important to an assessment of Massachusetts' infrastructure since providing clean and safe water to the state's citizens involves major financial and construction efforts and are part of the overall picture with respect to water. The following section of this report explores the quality of the water distribution system, the steps being taken to repair the water distribution infrastructure, and the ways these repair programs have been funded.

Water Supply

The problem of water supply in Massachusetts stems largely from the fact that most of the water in the state is found in the hilly western part of the Commonwealth, far from the population center along the eastern seaboard. The problem of supplying water to Massachusetts communities was, in the case of the Metropolitan District Commission, solved by developing new sources of water, involving construction of aqueducts and water tunnels that run halfway across the state. But,

Table 4-2

Recent Population Trends in Six Water-Supply Systems

City	1980 Population	Percent Change, 1970-1980
Boston SMSA	2.8 million	-4.7 percent
Boston[1]	2.7 million	1.0
MDC	1.8 million	
Brockton[1]	180,000	19.4
Fall River[2]	126,000	2.0
New Bedford[1]	133,000	-0.3
Springfield[2]	448,000	-1.7
Worcester[1]	276,000	11.6

Source: U.S. Bureau of the Census. 1982. 1980 Census, Table 14.

1 Urbanized area
2 Massachusetts portion of urbanized area

more recently, strong home-rule traditions plus an explicit state policy that discourages interbasin transfers of water have made it difficult for communities to share with each other without a legislative mandate to do so, although communities within a river basin can cooperate with each other, and such cooperation is encouraged by the state. A mandate for the water-rich west to share with the water-scarce east created the Metropolitan District Commission (MDC) in 1889, establishing one of the largest domestic water supply and distribution systems in the world.

Problems of the MDC water-supply system are related to the management of the water-distribution system statewide. The MDC has no statutory authority to mandate conservation or other savings for its member communities. Its responsibility is only to deliver water through its aqueducts and transmission lines to the municipal boundaries, at which point member communities gain control of their water supplies.

Existing Facilities and Age

Outside the MDC, the water supply and water distribution systems are characterized by fragmented, localized administration, with little statewide planning or management. In 1982 there were 363 central water-supply systems in 293 of the state's 351 cities and towns. These central systems were comprised of 68 private water companies, 78 fire and water districts, and 217 municipal water departments. Another 58 towns draw their entire water supplies from private on-site wells, but these 58 towns represent only 7 percent of the state's population, with central water supply systems serving the remaining 93 percent (Massachusetts Water Resources Commission, 1982b; see Figure 4-1).

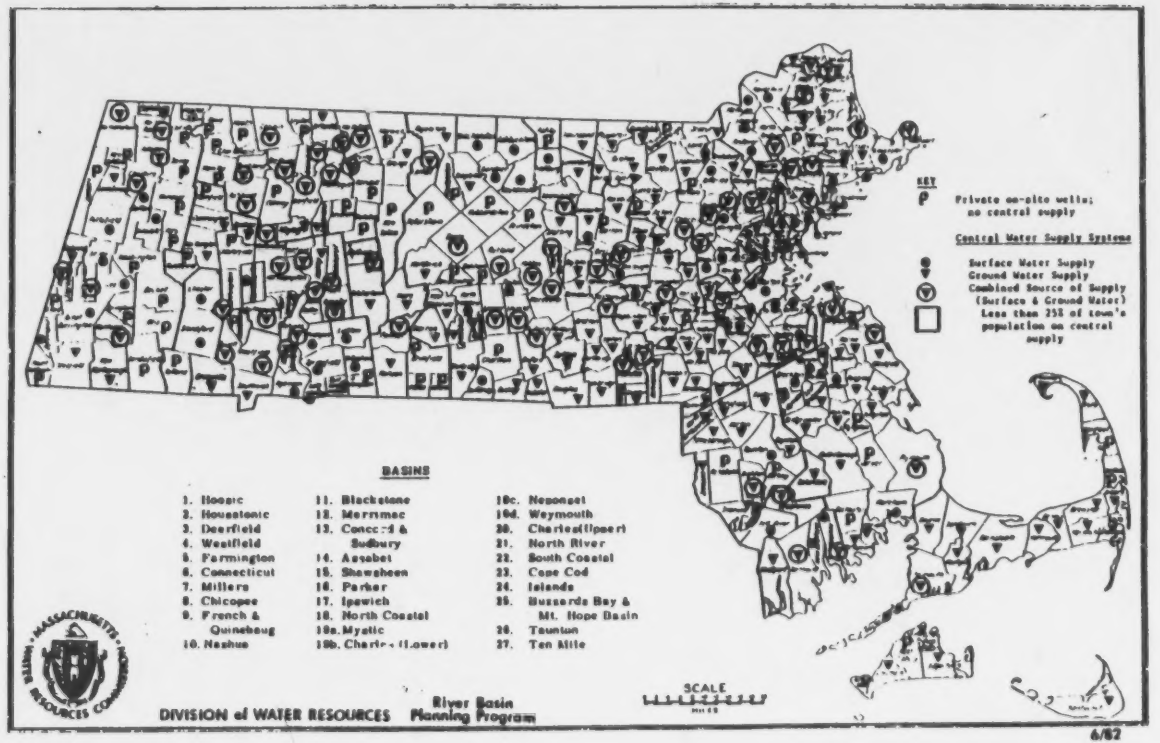


Figure 4-1. Source of Water Supply for Massachusetts Communities, 1982

Nearly half (47 percent) of the state's population is served by just six water-supply systems: the MDC, and the municipal (nonMDC) systems in Springfield, Worcester, New Bedford, Brockton and Fall River. These six systems serve a population of 2.7 million people (Massachusetts Water Resources Commission, 1982b).

Population trends in these areas are as shown in Table 4-1. Twenty-five communities receive their entire water supply and eight a partial supply from the MDC water division. The primary source of water for the 45 MDC-supplied communities is the Quabbin reservoir, an artificial lake with a capacity of 412 billion gallons (MDC, 1981) 65 miles west of Boston on the former site of four towns. This reservoir, developed between 1927 and 1946 in the Swift River Valley in the Berkshires to supply metropolitan Boston with water until the 1980s, provides high quality water that does not require treatment before use. Developing that water supply involved the displacement of 2,500 persons, the razing of 650 homes, elimination from the map of the Commonwealth the four towns of Dana, Enfield, Greenwich, and Prescott, and the relocation of 7,561 bodies previously buried in 34 cemetaries in the valley (Massachusetts Senate, Committee on Ways and Means, 1982a).

The rest of the MDC water supply comes from the Wachusett watershed and the runoff of the Ware River watershed during certain periods. The total storage capacity on these watersheds is 488 billion gallons (MDC, 1981).

This water supply is delivered to Metropolitan Boston through 131 miles of aqueducts and tunnels and distributed by gravity through approximately 260 miles of pipelines (MDC, 1981).

In addition, the MDC Water Division controls six storage reservoirs with 467 square miles of tributary watersheds, a water surface of 30,000 acres, four hydro-electric power stations, 16 miles of high-tension power transmission lines, distribution pumping stations (number unspecified) to high service elevations, and 16 distribution reservoirs with a capacity of 3.1 billion gallons (MDC, 1981; Massachusetts Senate, Committee on Ways and Means, 1982a).

Current Conditions

How much water is currently available to the six major urban water-supply systems (MDC, Brockton, Fall River, New Bedford, Springfield, and Worcester)? Is there enough water to supply a safe yield? Table 4-2 shows that most communities of 10,000 or more had ample water supplies as of the end of 1982, if the minimum per capita safe yield is set at 100 gallons per capita per day (Tabors, 1979). However, Figure 4-2 shows that many towns face shortages by the year 1990. Planning analysis is underway in the Executive Office of Environmental Affairs to help communities plan how to meet those shortages. Detailed plans to augment the water supplies of the municipalities that need them are found in Massachusetts Water Resources Commission 1982a.

By the end of 1980 the level of water in the Quabbin Reservoir was down to 85.3 percent of capacity although Metropolitan Water District members had reduced their demand by 8.7 million gallons per day (mgd). The average daily demand on the system between 1972 and 1980 was 315 mgd, even though the estimated safe yield of Quabbin is 300 mgd. The drought of 1961-1964 had reduced Quabbin to 45 percent of capacity, and water-supply managers project that, based on current consumption, a comparable drought today would cause a drop in the water level to 31 percent of capacity (Massachusetts Senate, Committee on Ways and Means,

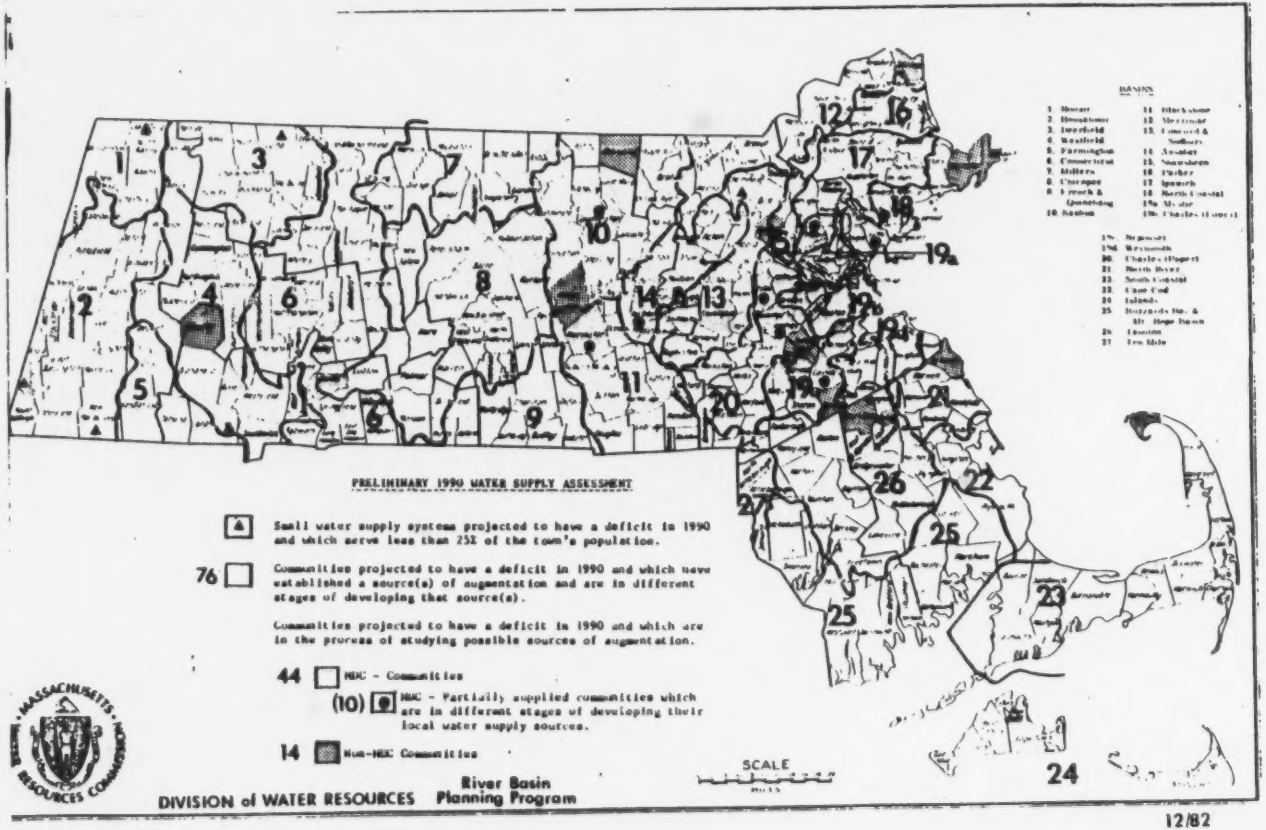

PRELIMINARY 1990 WATER SUPPLY ASSESSMENT
Small water supply systems projected to have a deficit in 1990 and which serve less than 25% of the town's population.
76
Communities projected to have a deficit in 1990 and which have established a source(s) of augmentation and are in different stages of developing that source(s).
Communities projected to have a deficit in 1990 and which are in the process of studying possible sources of augmentation.
44
MDC - Communities
(10)
MDC - Partially supplied communities which are in different stages of developing their local water supply sources.
14
Non-MDC Communities
SCALE
DIVISION of WATER RESOURCES
River Basin Planning Program
12/82

Figure 4-2. Projected 1990 Water Supply Status for Massachusetts Communities--Preliminary Assessment

1982a).

Beginning in December, 1979 and extending through late 1981, Massachusetts experienced a two-year dry spell that dramatized the water supply problems of many towns and cities across the state. At the height of the drought in November 1981, 42 communities were operating under state-declared water emergencies, and an additional 19 communities were under voluntary water-use restrictions. In April 1982, 24 communities were under state-declared emergency water bans, and 11 others had imposed voluntary water bans, with another 21 communities listed by the state's Department of Environmental Quality Engineering as facing potential water shortages during drought conditions (Massachusetts Senate, Committee on Ways and Means, 1982a).

The water shortage of the late 1970s and early 1980s caused the MDC to stop accepting into the Metropolitan Water District new members outside of a statutorily-mandated 10-mile radius of the Massachusetts State House until an additional water supply is obtained. Four metropolitan Boston communities have been affected by this moratorium on new members-- Bedford, North Reading, Stoughton, and a section of Lynnfield (MDC, 1981).

In addition, several towns have had severe water-supply problems recently, either through under-supply or loss due to contamination. For example, the affluent town of Weston lost its local water supply due to salt contamination from road salting along Route 128 (Interstate 95), which runs through the town, and became a partial member of the MDC water system (Massachusetts Senate, Committee on Ways and Means, 1982a).

Provincetown on Cape Cod lost access to most of its groundwater supply because of a leak from an underground gasoline storage tank next

to the aquifer, and since 1978 has relied on emergency water supplies pumped through above-ground pipes from the Cape Cod National Seashore and from the North Truro Air Force Station (Massachusetts Senate, Committee on Ways and Means, 1982a).

In September 1980, the University of Massachusetts in Amherst sent its students home because the town's water supply was inadequate to supply the university. Although the population of Amherst had increased during the 1970s as the University grew, no new source of water had been developed since 1970, and water conservation efforts had only produced a two percent decrease in water consumption in 1979 (Massachusetts Senate, Committee on Ways and Means, 1982a, pp. 6-84).

Needs

All of the above are examples of the consequences of unplanned water management and local inability to solve local water-supply problems. As the Senate Ways and Means FY83 budget report states, "the need for effective regional water management is clear" (Massachusetts Senate, Committee on Ways and Means, 1982a, p. 6-85).

Although the recent drought is now over, the problems that so many Massachusetts communities face in times of lower than average rainfall have not been solved, and they will not be solved until coordinated planning and management of water supply resources are the rule rather than the exception.

The MDC water supply needs augmentation. That system is exceeding the daily safe yield of 300 million gallons per day (mgd) from Quabbin Reservoir by about 20 mgd (MDC, 1981; Massachusetts Senate, Committee on Ways and Means, 1982a). The "safe yield" is a technical concept that defines the appropriate level by which a body of water can

be drawn down and still be replenished by rainfall under normal circumstances. The 20 mgd shortfall, with recorded peak consumption as high as 479 mgd, means that the MDC must expand its sources of supply and/or reduce water usage in that system or, as has been suggested, plug up the leaks in the system. Although some officials estimate that up to 20 mgd could be saved if all the leaks in the member communities' water distribution systems were repaired, that 20 mgd would solve just the immediate shortfall problem but would not enable the MDC to serve future growth needs or allow connections to the MDC system by localities that have lost or are losing their own water supplies. Because the 2 million residents in the MDC water district consume 320 million gallons of water each day and the Quabbin/Wachusett reservoir system only provides a safe yield of 300 mgd, new sources of water are being sought for the MDC water system (Massachusetts Senate, Committee on Ways and Means, 1982a).

Plans

Some legislators believe that a regional approach to supplying localities with their water would provide advantages to both water-rich and water-poor communities, with a goal of developing and managing water resources efficiently and cost-effectively (Massachusetts Senate, Committee on Ways and Means, 1982a). Poor local planning exacerbated by inadequate water supply and drought have combined to cause many of the recent water shortages in the Commonwealth; therefore, an obvious prescription is better planning and management. However, legislation to establish a regional district to coordinate water supply in the chronically water-short southeastern part of the state, under discussion by the Massachusetts Senate, Committee on Ways and Means Committee (1982a), was never drafted or submitted, and is not under active

consideration by the state legislature.

The MDC has commissioned an environmental impact report to study various options to increase the physical supply of water available to MDC communities, the largest single supplier of water in the state. Although it is state policy (adopted separately by the Executive Office of Environmental Affairs and the General Court) that the transfer of water from one basin to another is to be utilized only as a last resort, the staff at the MDC are looking into several approaches to augmenting its water supplies, some of which would involve diversions of water from areas west of the Metropolitan Boston area into the MDC pipelines. These diversions would be considered only after other measures to increase water supplies are undertaken, if feasible (Massachusetts Senate, Committee on Ways and Means, 1982a).

A long-range water-supply study to meet needs until the year 2020 was commissioned by the MDC and is expected to be completed in 1984 (Massachusetts Senate, Committee on Ways and Means, 1982a). The staff conducting this study will assess eight alternatives that have been proposed as solutions to the MDC water-supply needs and will evaluate and report on the probable environmental impacts of the various proposals (Massachusetts Senate, Committee on Ways and Means, 1982a: Elizabeth Kline, Executive Office of Environmental Affairs, personal communication). The eight alternative projects are:

1. Development of the Upper Sudbury River watershed
2. Merrimack River flood skimming
3. Connecticut River tributaries flood skimming (Millers river)
4. Development of groundwater and surface water in MDC member communities
5. Water conservation, including repairs to distribution systems
6. Quabbin watershed management
7. Connecticut River flood skimming
8. No action

In addition to assessing the environmental, engineering, social, economic, and water-yield costs and benefits of the various alternatives, the study will contain a forecast MDC water needs over the 40-year period and will include potential demands on the system by new communities. The study area includes 300 Massachusetts cities and towns as well as future needs of New Hampshire and Connecticut in relation to the Connecticut and Merrimack River alternatives.

In the interim, the MDC is pilot-testing ways to restore a previously utilized water supply from the Sudbury river system, and is testing ways to make that water meet modern quality standards. Reactivating the Sudbury Reservior can provide up to 20 mgd, and is seen as an interim solution to the present safe-yield deficit. The long-range study will assess using up to 25 mgd more water from the entire Sudbury system (Massachusetts Senate, Committee on Ways and Means, 1982a).

Water Distribution

The system developed over the years to transmit water from its source to the individual household or business will now be examined. The state has recently provided the towns and cities, both inside and outside of the MDC, with a way to begin to repair their water-distribution systems. In the previous section on water supply, it was shown that the water-shortage problems of recent years is partly attributable to a prolonged period of low rainfall. But, some officials attribute part of the water shortage to losses of high-quality water supplies through leaks and breaks in the pipes and aqueducts of the water distribution system (Massachusetts Special Legislative Commission, 1977).

The problems of old water pipes have been cited as the "single greatest need" of older cities and towns (Massachusetts Special Legislative Commission, 1979, pp. 18), and the cost of repairing or replacing water supply and distribution systems was recognized as one of the major reasons for a recent shift in attitude within the state from a perception of water as an abundant resource to a perception of scarcity (Massachusetts Special Legislative Commission, 1979). There has been no parallel commitment to an assessment on a statewide basis of the condition of water-distribution systems across the state.

Existing Facilities and Age

A special legislative commission established in 1977 pointed out that:

> antiquated pipes in the older municipalities are responsible for major losses of potable water which . . . strain inadequate supplies [and mean] loss of pressure for adequate fire protection and degradation of water quality (p. 12) . . . the single greatest need of the oldest cities and towns in the Commonwealth is for financial assistance for the rehabilitation of their water distribution infrastructure. . . . In order to maintain the economic viability of their communities and to compete with more recently developed areas, officials in the state's older communities and urban centers realize that their distribution systems must be renovated (Massachusetts Special Legislative Commission, 1979, p. 51).

Despite this purported widespread understanding, there is now no way for town and city managers to obtain data on the condition of their water distribution infrastructure to use for planning purposes. All information used in this report was pieced together from a variety of sources, and for most communities it is simply not available.

As one of the oldest states in the union, it is not surprising that Massachusetts has municipal water-distribution systems that are among the oldest in the country. Boston has America's first piped water

system, begun in 1652. This system delivered water from springs and wells to a location near the present-day Quincy Market; water was stored in wooden tanks from which citizens filled buckets. In the late 18th century, Boston developed one of the nation's earliest municipal water systems, and pipes laid in 1853 are still in use (Comptroller General, 1980).

Other Massachusetts cities also have some very old water mains; Table 4-3 shows some of the ages. The oldest mains in Worcester were laid in 1832; in Brookline, in 1874; in Chelsea, 1868; in New Bedford, 1869; in Fitchburg, 1872. Although most of these mains are made of cast or ductile iron, which generally provide long-lived satisfactory service (a cast iron main laid in Versailles, France in 1664 is still in use, according to Comptroller General, 1980), these materials are prone to a kind of internal corrosion called "tuberculation."[1]

Current Conditions

The Southeastern Regional Planning and Economic Development District (SRPEDD) reports that water pipes in Fall River are "badly deteriorating," in fact they are "deteriorating faster than upkeep," (response to Massachusetts Infrastructure Study questionnaire) although upgrading is underway through cement lining. More repair of the old lines is needed, and some will be funded through the Community Development Block Grant program. However, the planner reports

---

1 Tuberculation both reduces the effective flow of water through the pipes by reducing the available diameter, and provides lodging places for bacteria and other undesirable elements to breed. Tuberculation can be corrected by in-place cleaning and lining with a thin layer of cement mortar, a process that costs about half the replacement cost (GAO, 1980).

Table 4-3

Number of Miles of Water Mains in Selected Towns,
Age of Oldest Mains,
And Percentage of System Metered, 1979

Town	Population	Miles of Water Mains	Age of Oldest Mains	Percent Metered
Arlington	na	127	na	na
Boston	641,000	1,080	1853	100
Brookline	56,000	135	1874	100
Chelsea	25,070	62	1868	100
Fitchburg	40,000	181	1872	100
Gloucester[1]	28,000	120	1885	60
Lowell	90,000	260	1868	100
Lynn	80,000	125	1880-1920	82
Malden	54,200	115	1880s	100
New Bedford	148,600	277	1869	98
Newburyport	17,000	74	1889	100
Newton	85,200	305	1880s	100
Peabody	47,000	160	1900s	98
Somerville	80,000	116	1864	100
Worcester	172,500	963	1832	100

Source: John A. Bewick, Special survey, Executive Office of Environmental Affairs, 1979

[1] Population figure is for permanent, i.e. winter, population.

that although a treatment plant is needed on South Watuppa Pond to provide more water supply, no local money is available to fund that plant (questionnaire reponse, MIS survey).

Good information was provided by the Old Colony Planning Council (OCPC) serving the Brockton region. This regional planning council estimated that of the thirteen communities in their region, the condition of pipe in municipal water distribution systems, many of which date back to the late 1800s, was as follows (OCPC, 1983):

poor	4 communities
fair	1 community
good	7 communities
very good	1 community

Of the 1,242 total miles of water pipe in the 13 communities of the OCPC region, pipe types were as shown in Table 4-4. Although some towns in the OCPC region have problems with tuberculation and sedimentation in their older mains, the primary problem for most communities was low flow rate due to undersized mains. The OCPC estimates that an average of 26 percent of the water pipes in the OCPC region needs to be replaced, with community estimates ranging from 1 percent to 30, 40, 50 and even 60 percent replacement (OCPC, 1983).

The Northern Middlesex Regional Planning Council estimates that the total mileage of water pipes in towns and cities with central water supplies is quite close to the road mileage of those communities. In the city of Lowell, there were 260 miles of pipe and in 1979 the City allocated $1.2 million to the water department (Northern Middlesex

Table 4-4

Water Distribution in the Old Colony Planning Council Region

Kind of Pipe	Number of Miles	Number of Communities Reporting	Chronology of Installation
small diameter, unlined, cast iron	508	9	pre-1940
asbestos/cement (A/C)	249	8	1940-1970
Cement-lined A/C, ductile, PVC, transite, galvanized pipes	138.5	unknown	1970-present

Source: OCPC, 1983.

Regional Planning Council, response to Massachusetts Infrastructure Study questionnaire).

Maintenance Plans

The meters used to measure water consumption by both individual households and municipalities receiving water from the MDC system are old, and many have not been functioning correctly. The MDC staff is converting their revenue meters from manual to computer-controlled meters. Manual revenue meters, currently read by a person who descends into the tunnels and manually records the readings, are being converted to computerized meters, which can be read from a central console at MDC headquarters and should be on-line in one year (MDC Planning Director Interview, March 1983). This will greatly improve the efficiency of the system.

Water pricing is also an issue. In the past, many water systems operated on the principle that the largest users paid the lowest per-unit costs, a practice that encouraged waste. Gradually, water systems across the state are converting to a pricing system that charges an equal per-unit cost to small and large water users, a policy that will both encourage conservation of water and produce higher revenues for local water departments. These higher revenues can, in turn, finance some of the needed maintenance and construction in the localities. Local revenues are needed because both the state and federal grant programs require matching funds from municipalities.

A Special Legislative Commission set up to study problems in the water-distribution infrastructure system said in 1979 that "Massachusetts cannot afford to wait any longer, and must begin to address this serious problem [of deteriorating water pipes] by

initiating its own rehabilitation program" (Mass. Special Legislative Commission, 1979, p. 12). The next year, Chapter 805 of the Acts of 1979 (Mass. Acts 805, 1979) was passed, providing $10 million for this purpose; in 1982, Chapter 286 (Mass. Acts 286, 1982) allocated another $60 million for Leak Detection and System Rehabilitation of water distribution systems in the state. These programs were funded through bonds issued by the Commonwealth of Massachusetts.

Grants under Chapter 805 were first awarded in March of 1982, and in the 1982 legislative session, the General Court of the Commonwealth of Massachusetts passed one of the most comprehensive and innovative pieces of water legislation enacted in the country. Having given up on obtaining funding from the federal government, the state decided to take action on its own.

Chapter 286 provided a total of $357.5 million for a set of programs, which, in addition to the leak detection and system rehabilitation programs, provide for water-filtration plants, aquifer cleanup from chemical contamination, groundwater site acquisition for water-supply protection, and public-building retrofitting for water conservation. One purpose of this act, according to a legislative summary, is to provide local aid to cities and towns to help them, in light of Proposition 2 1/2 restrictions, realize the savings possible with good water management. This aid is in the form of matching grants available only to communities that have completed, or are in the process of completing, a comprehensive water-resource management plan.

Since March of 1982, a total of 117 towns and cities have been awarded leak detection grants under this program, and 23 received leak detection grants twice. Of the 293 municipalities with central water

systems, 117, or just under 40 percent, have applied for funds to detect leaks in the water distribution system (see Figure 4-3).

Under these grants, water department personnel in the communities search out, with sensitive acoustical devices, places where water is leaking either through breaks in pipes or through defective joints. When the sound of running water reveals a source of leakage, the town then can apply for the next segment of the program, system rehabilitation. Table 4-5 summarizes the awards already made under this program.

Maintenance Costs

What would it cost to rehabilitate existing water pipes? In 1979, Boston estimated that the average costs of cleaning and lining pipes was $56 a foot, compared to $122 a foot to replace (Executive Office of Environmental Affairs, 1979 survey). In the same year, the town of Newburyport estimated that rehabilitation of their water system would cost $70 per foot (Executive Office of Environmental Affairs, 1979 survey). The estimates of other towns and cities are shown in Table 4-6. Because no estimate was available of the number of feet of pipe in need of rehabilitation across the state, the cost of system rehabilitation could not be determined.

The system rehabilitation portion of the Chapter 286 (see Table 4-7) accounts for 95 percent of the expenditures in this category (leak detection is held to only 5 percent of the total grant amount). Since March 1982, a total of $24.5 million have been awarded to 129 communities (Massachusetts Department of Environmental Quality Engineering, Memorandum, January 1983b).

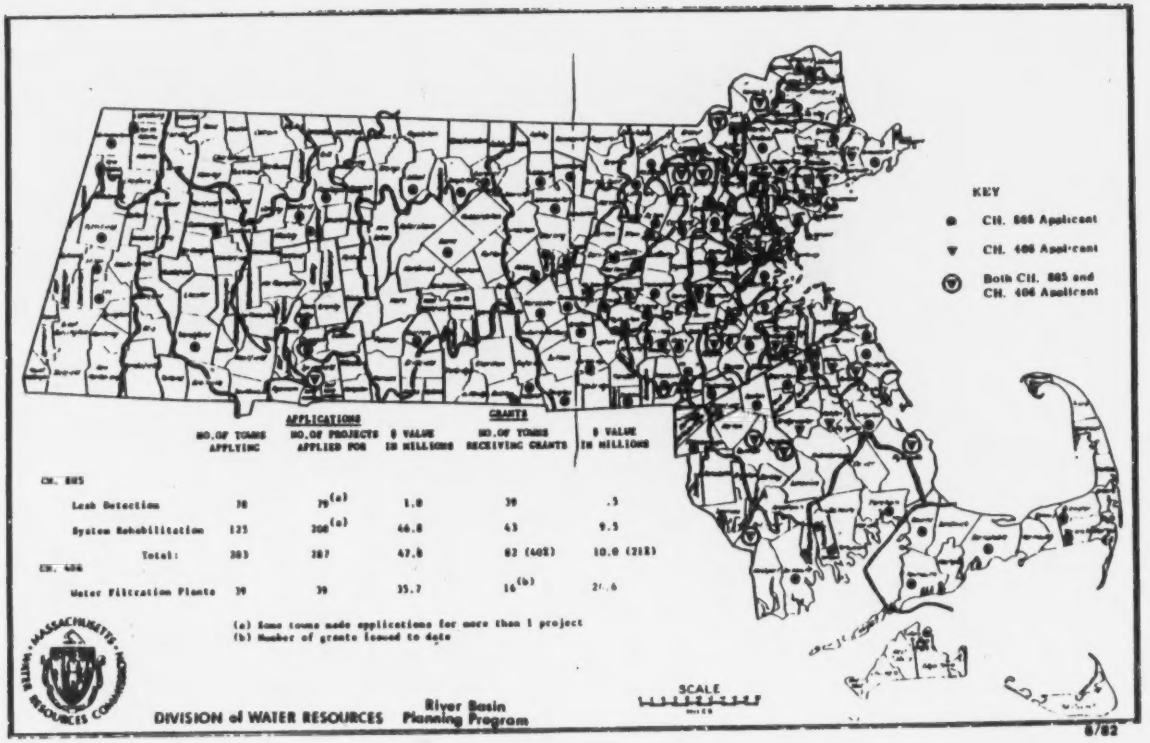

KEY
Ch. 805 Applicant
Ch. 406 Applicant
Both Ch. 805 and Ch. 406 Applicant
APPLICATIONS
GRANTS
NO. OF TOWNS APPLYING
NO. OF PROJECTS APPLIED FOR
$ VALUE IN MILLIONS
NO. OF TOWNS RECEIVING GRANTS
$ VALUE IN MILLIONS
Ch. 805
Leak Detection 78 79(a) 1.0 39 .5
System Rehabilitation 125 208(a) 46.8 43 9.5
Total: 303 287 47.8 82 (40%) 10.0 (21%)
Ch. 406
Water Filtration Plants 39 39 35.7 16(b) 21.6
(a) Some towns made applications for more than 1 project
(b) Number of grants issued to date
DIVISION of WATER RESOURCES
River Basin Planning Program
SCALE
8/82

Figure 4-3. Communities Applying for 405 and 805 Local Assistance Grant Programs

Table 4-5

Summary of Leak Detection Grants Awarded, through 1983

	Date Awarded	Number of grants	Total awarded
Phase I Chapter 805	March 1982	39	$500,000
Phase II Chapter 286	September 1982	40	$500,000
Phase III Chapter 286	February 1983	61	$1.03 million

Source: Leak Detection Grants (Summary Sheet), Department of Environmental Quality Engineering, Division of Water Supply, 1/15/83; Press Release, February 24, 1983, from the Secretary of Environmental Affairs.

Table 4-6

Estimated Cost of Rehabilitation and Replacement, and Method of Water Department Financing, 1979

Town	Replacement Cost (millions)	Rehabilitation Cost (millions)	Method of Financing[1]
Arlington	na	na	
Boston	$300	$100	self supporting
Brookline	100	27	subsidized
Chelsea	2.5	2.5	subsidized
Fitchburg	96	38	subsidized
Gloucester	50	20	subsidized
Lowell	20	8	self supporting
Lynn	75-100	61	subsidized
Malden	70	8	self supporting
New Bedford	na	32	subsidized
Newburyport	15-20	10	self supporting
Newton	48	26	subsidized
Peabody	30	5	subsidized
Somerville	na	$30,000/yr[2]	independent
Worcester	168	60	subsidized

Source: John A. Bewick, Special survey, Executive Office of Environmental Affairs, 1979

1 "Self-supporting" means that revenue is generated by user fees; "subsidized" indicates that funds are received from the general treasury of the community, and revenues are intermingled in that same treasury.

2 This is an estimate for the cost of rehabilitating only the water meters in Somerville.

Table 4-7

Summary of System Rehabilitation Grants Awarded through 1983

	Date	Number of grants	Total awarded
Phase I Chapter 805	March 1982	43	$9.5 million
Phase II Chapter 286	September 1982	86	$15 million
Phase III Chapter 286	Spring 1983	179 (applications)	$72 million requested, $14.5 million available

Sources: Massachusetts Department of Environmental Quality Engineering, System Rehabilitation (Summary Sheet), Division of Water Supply, 1/25/83; Press Release, February 24, 1983, from the Secretary of Environmental Affairs.

This spring the state will award another $14.5 million dollars to communities around the state for system rehabilitation grants to remedy health problems in community water systems associated with water quality or with safety problems associated with loss of water pressure for fighting fires. Over the past several years, 204 water districts have applied for system rehabilitation grants, and of these, 101 have applied more than once (Massachusetts Department of Environmental Engineering, Memorandum, January 1983b).

The state has received requests for a total of $72 million, even though only $14.5 million is available from the Department of Environmental Quality Engineering for these purposes (Massachusetts Department of Environmental Engineering, Memorandum, January 1983a). This indicates that the need is substantially larger than the ability of the state to fund these grants, even on a matching basis. The $72 million is for only half the amount of the rehabilitation necessary, since the state grant is a 50 percent matching grant. The actual construction need is, consequently, $144 million, of which only $29 million, or 20 percent, will be funded this year (Massachusetts Department of Environmental Engineering, Memorandum, January 1983a; interview, Elizabeth Kline, Executive Office of Environmental Affairs, February 1983).

In Fiscal 1981, the last year for which data are available, the MDC Water Division awarded ten contracts for construction work, maintenance and repairs on its system, for a total of $2,583,890 (MDC, 1981). The MDC Water Division has begun to replace sections of corroded steel pipelines and to reline the Weston Aqueduct. A $1.3 million pipeline across Spot Pond Reservoir was completed in 1981, connecting the Spot Pond Pumping Station with a 48-inch pipeline to Woburn. Design

began to extend this pipeline to Route 128 and to the Wakefield town line, and construction started on a $3.8 million pipeline to improve water pressure in the Lynn area (MDC, 1981).

As part of its ongoing maintenance program, in 1981 the MDC repaired and rebuilt two generators at the Cosgrove Power Plant in Clinton, erected a metal picket fence at the Waste Channel at Wachusett Dam in Clinton, installed an altitude valve at Turkey Hill Reservoir in Arlington, relined sections of the Weston Aqueduct, and installed a slate-covered, wood-structured frame roof on the Old Stone Church in West Boylston (MDC, 1981).

Construction Plans

Apart from the next allocation of Chapter 286 funding in the Spring of 1983 for system rehabilitation, project staff could not ascertain state plans for the water-distribution system. The Massachusetts Department of Environmental Quality Engineering may engage a consultant to assess the quality of the local water distribution systems in the state's cities and towns, but no decision has been made and no contract has been awarded. Because it was very difficult, and impossible in some cases, to obtain information on the number of miles of water and sewer lines in the communities, such an assessment would be worthwhile. The quality of the local water mains and of local sewage collection systems is also, for the most part, unknown, and merits further study.

There is no information available on the number of communities without a water-distribution infrastructure that need one. This would be difficult to predict, because the need for infrastructure is dictated either by economic or population growth, or because an existing supply

has been contaminated and new lines must be laid to provide water from another area.

Massachusetts will need between $1 and $2 billion over the next decade to maintain and rehabilitate the water-supply distribution system (Business Week, October 1981). An illustration of the problem comes from the 1980 Annual Report of the town of Dunstable, in the Northern Middlesex Regional Planning Council area:

> It was another year of frustration in the Water Board's struggle to keep the [water distribution] system in operation. The well and system maintenance expenses reflect the major problems. Limited funds allow only the minimum corrective action at today's costs (Robert W. Flynn, 1983).

SUMMARY

The current and expected revenues and expenditures on water-supply infrastructure are presented in Table 4-9. Because local government data were not readily available, it was not possible to determine the potential gap between expected revenues and needs. If no revenues were forthcoming from either the federal or local levels, the shortfall may be as great as $844 million. A more detailed discussion of these estimates is provided in Part 6.

Table 4-9

SUMMARY OF CAPITAL INVESTMENT NEEDS
AND REVENUES IN MASSACHUSETTS
(millions of 1982 dollars)

Water Supply

Needs for Selected Periods	
Period	1983-1990
Total Need	$520[a,b]
Average Annual Need	$65
Need to Year 2000	$1,150
Average Annual Expenditures[o]	$17
Total Expected Revenue to Year 2000[p]	
Total	$306
Federal	--
State	$306
Local	n.a.
Expected Revenue Minus Expected Need to Year 2000	n.a.

SOURCE: Refer to Table 6-1.

[a]Calculation based on maintenance of safe yield and guarantee of 150 to 200 gallons/capita/day. (The EPA standard is 100 gpd; over estimate accounts for distribution within state and for annual variations.) The present system's yield of 215 gpd is for 87 percent of population. If 90 percent of population (6.7 million) served in 2000, then require a maximum of 131 MGD safe yield additional supply. Supply estimates are $2 million/MGD or $260 million.

[b]Includes estimated $357.5 million over 10 years for water-supply improvements under Chapter 286.

Part 5

ENVIRONMENTAL INFRASTRUCTURE--SEWERAGE SYSTEM

Just as in the case of the infrastructure for water, the sewerage system infrastructure can be analyzed in two parts, one a system for collection of sewage from sources, and another a system for treatment of that sewage with the goal of reducing or eliminating sewage as a source of water pollution. As in the previous section on water, analysis of the infrastructure for sewerage will proceed in two parts. First, existing water-pollution control/sewage-treatment facilities in the state will be discussed, and the needs of this system as projected by the state's Division of Water Pollution Control will be presented. Next, the little information available about the sewerage system will be presented, and the need for more data collection will be reviewed.

The sewage-treatment portion of the infrastructure is fairly well documented both in terms of existing facilities and projected needs, but the locally funded and administered sewage-collection systems in the cities and towns (outside the MDC system) are almost completely undocumented and unstudied, except for those municipalities that have applied for construction grants for pollution control.

Although the needs of local systems have been studied, there is no one source for answering the question of how many miles of sewer exist in each municipality, and what condition they are in. Some of the information could be analyzed if the 201 facilities' plans were obtained, but there was insufficient time to conduct this analysis for the present report. The state only has responsibility for administering grants to municipalities and sewer districts to defray the capital costs of construction of wastewater treatment plants, interceptor sewers, and pump-

ing stations. Local connections between interceptors and homes or commercial buildings are under the planning and financial jurisdiction of the cities and towns, and their condition is not routinely monitored (Interview with Paul Taurasi, Department of Environmental Quality Engineering, March 1983).

Sewage Treatment

Water-pollution abatement in all municipalities is the responsibility of the state's Division of Water Pollution Control in the Department of Environmental Quality Engineering (DEQE). This office administers all grants to municipalities and sewer districts for water pollution control.

According to the Chief Engineer of the Construction Grants Program at the DEQE, the biggest problem of the sewerage infrastructure is not its pipes, but funding the multitude of new facilities needed for water-pollution control (interview, March 1, 1983). Over the past ten years, according to this source, about $1.5 billion has been spent on water-pollution cleanup, building or renovating 40 to 50 wastewater treatment plants. This massive cleanup program has resulted in a significant improvement in the quality of many of the Commonwealth's bodies of water. In 1970, just 16 percent of the state's rivers, streams, and lakes were swimmable or fishable, but by 1983 fully half were suitable for these recreational uses. Particular improvements were noted in the Merrimack and Connecticut rivers.

For example, in the Northern Middlesex Regional Planning Council area, which includes the city of Lowell that was a major contributor to pollution of the Merrimack River,

> the communities . . . have recently been coming to terms with the issues of municipal sewage collection and treatment. Until the 1970s, only the city of Lowell had a municipal sewerage system, with all of the suburban communities relying on septic tanks and cesspools. Even within the City, however, the collected sewage was discharged directly into the local waterways without any sort of treatment. There are now three plants operating within the region, covering parts of six of our nine communities (Robert W. Flynn, 1983).

These construction programs were financed largely by the U.S. Environmental Protection Agency (EPA), which provided 75 percent matching grants to fund construction of these projects. The state put up 15 percent of the funding, and the municipalities contributed 10 percent of the cost.

Existing Facilities and Age

All of the wastewater treatment facilities in the state as of 1980 are published in Massachusetts Division of Water Pollution Control (1980). This listing shows that the oldest operating wastewater treatment facility in the state was built in 1929 on Nantucket Island. A few facilities still in use were built during the 1940s, such as the one in Falmouth on Cape Cod, one was built in 1959 in Milford, and one in Millis in 1967, but most facilities were built during the 1970s. The two major sewage treatment plans in the state, the Deer Island and Nut Island facilities, serving the MDC sewerage district, were built in 1967 and 1952 respectively. See Table 4-8 for the ages of some treatment plants in the SRPEDD region.

Current Conditions

The major issue in sewage treatment in Massachusetts today is the clean-up of Boston Harbor. During 1981 the MDC Sewerage Division began several projects aimed at cleaning up the Harbor and the neighboring waters of the Charles, Mystic, and Neponset Rivers. However, action by the MDC alone cannot completely solve the problem because combined

Table 5-1

SRPEDD District Sewage Treatment Facilities

Community	Year Treatment Plant Built	Capacity	Self-rating	Annual O/M Expenditures
Attleboro	1980		Excellent	$500,000[1]
North Attleboro/ Plainville	1980		Excellent	$300,000
Fairhaven	1971		na	na
Fall River	1982	31 mgd	Excellent	
Marion	1973[2]	.67 mgd	na	na
Middleborough	1975		good	
New Bedford	1974[3]		good	
Taunton	1978	5 mgd	excellent	

Source: MIS survey questionnaires

1 100% increase in annual maintenance expenditures in year new plant brought on line.

2 Sewer lagoons

3 Primary treatment only; secondary treatment needed, especially when considering needs to year 2000. Also needs to separate CSO systems. Expected costs of these needs: $100 million or more. Expect revenues to come from user charges.

sewage overflows from cities and towns all along the shoreline contribute tremendous volumes of pollutants to the harbor's waters (Elizabeth Kline, Executive Office of Environmental Affairs, personal communication).

The multi-million dollar program undertaken by the MDC is the outgrowth of recommendations made in a study completed in 1976 (Eastern Massachusetts Metropolitan Area, or EMMA, study). The principle recommendations of the EMMA study that are now being pursued are the upgrading of the Deer Island and Nut Island sewage-treatment plants; the elimination of sludge discharge into the harbor waters; an area-wide combined sewer-overflow abatement program; and extensions, repairs, and improvements to the MDC sewerage system. Many of the ongoing projects are financed in part by federal and state funds, under the Federal Water Pollution Control Act Amendments of 1972 (U.S. Congress, PL 92-500), enforced by the EPA.

The Charles River Marginal Conduit Project began in 1976 and was completed in 1981. This facility is designed to treat combined sewage flow from storms, and discharges the flow into Boston Harbor below the Charles River Dam. Two other combined sewer-overflow treatment facilities in the Charles River, in Cambridge and in Somerville, have helped to reduce the amount of solids and harmful bacteria discharged into the basin, and will make an appreciable difference in the upgrading of the Boston Harbor waters (MDC, 1981).

Other facilities (Relief of the Millbrook Valley Sewer and Relief of the Framingham Extension Sewer) are underway to rehabilitate or replace interceptor sewers and pumping stations in the Metropolitan Sewerage District (MDC, 1981).

Maintenance Costs

The Northern Middlesex Regional Planning Council provided the following current annual maintenance expenditures for four of their six treatment facilities:

Community	Annual Maintenance Expenditures	Capacity
Billerica	$ 434,000	1.6 mgd
Dracut	157,000	na
Lowell	2,300,000	32 mgd
Pepperell	113,000	0.7 mgd

No estimates could be obtained on the maintenance cost of other water-pollution abatement facilities.

Construction Costs

Over the past ten years, $1.5 billion has been spent in the state to improve the sewage-treatment system. Of this cost, 75 percent has come from the U.S. Environmental Protection Agency (EPA) and 15 percent from the state. The state funded its portion from two bond issues, one for $150 million issued in 1969 and one for $250 million issued in 1970, for a total of $400 million to date. This money is nearly exhausted, but the recent passage of Chapter 286 of the Acts of 1982 authorized an additional $358 million bond issue, of which $250 million is earmarked for water-pollution control (DEQE, Memorandum, January 1983a).

Construction Needs

The DEQE has prepared a prioritized list of projects (see Exhibit 4-1) that are eligible for matching funds from the EPA for the purposes of water-pollution control. This list, which totals $1.6 billion of new projects over the next 4 to 5 years (according to the Chief Engineer of the Construction Grants Program at the DEQE), includes 208 projects in localities from Boston to Pittsfield, and Lowell to Nantucket.

31-895 O - 84 - 10

The clean-up of Boston Harbor is a major need in the state. According to the DEQE, "Boston Harbor may well be the state's single most important resource and involves a broad spectrum of activities from commercial shipping to shellfishing" (Massachusetts DEQE, Memorandum: Boston Harbor Cleanup, February, 1983). It is estimated that cleaning up the harbor can double the present annual yield of 20,000 bushels of clams, increase the use of beaches along the shore, and increase both the recreational and development value of both the waterfront and the harbor islands.

Exhibit 5-1

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING
DIVISION OF WATER POLLUTION CONTROL
ONE WINTER STREET, BOSTON, MASSACHUSETTS

Pursuant to Section 106 of the Federal Water Pollution Control Act of 1972, as amended; NOTICE is hereby given that a Public Hearing will be held before the Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control, on Tuesday, August 31, 1982 in the tenth floor Conference Room, One Winter Street, Boston, Massachusetts, at 10:00 a.m. The purpose of the hearing is to receive comments on the Commonwealth's Federal Construction Grants Project Priority List for Fiscal Year 1983, which identifies community projects expected to receive Federal grants during the year.

This list is based upon available funds carried over from Fiscal Years 1981 and 1982 and an assumed National Appropriation of $2.4 billion for Fiscal Year 1983. Massachusetts' allocation for FY-83 would be $83.0 million of the $2.4 billion, but would be proportionately reduced as the Nation Appropriation decreases. Projects below the heavy line on the Fundable List will probably not be funded without the National Appropriation.

It should be further noted that the Priority System continues to stress and assign high priority to projects which will significantly improve the quality of the Waters of the Commonwealth as well as provide public health protection.

By Order of Thomas C. McMahon, Director

COMMONWEALTH OF MASSACHUSETTS, DIVISION OF WATER POLUTION CONTROL CRITERIA FOR ESTABLISHING PRIORITIES FOR GRANTS UNDER FEDERAL WATER POLLUTION CONTROL ACT AND THE MASSACHUSETTS CLEAN WATERS ACT, FISCAL YEAR 1983.

1. Eligible Projects

Projects which have been submitted to the Division of Water Pollution Control and meet the requirements of the Division and the rules and regulations adopted by the Environmental Protection Agency shall be known as eligible projects.

At the time of submittal of an application for funding of an eligible project for which priority has been established, the applicant must show that funds have been appropriated to pay the remaining costs of the project over and above the grant.

2. Certification for Priority

To be considered for funding priority, completed applications must be submitted to the Division at the earliest possible time and preferably by July of the fundable year.

Projects will be certified annually for grants in the maximum amount eligible as requested in the application to the extent the funds are made available to the State.

Priorities will be given to eligible projects on the criteria which are explained below. Projects can be funded only if they are listed on the fundable portion of the Project Priority List or as otherwise provided herein.

All projects submitted for funding are reviewed to assure conformance with Water Quality Management plans.

3. Criteria System for Ranking Construction Grants Projects

General

In evaluating different types of projects, first consideration will be given to projects that will provide a minimum of secondary treatment or are needed to meet water quality standards. Projects of this type are wastewater treatment plants, outfall sewers, major intercepting sewers, major pumping stations and force mains. Also receiving high priority are projects that utilize alternatives to conventional treatment systems and projects that correct infiltration/inflow problems where the projects are needed to maintain the integrity of an existing or proposed wastewater treatment system project.

Projects for the separation of combined sewers and treatment of combined sewer overflows are considered lower priority projects than the projects indicated above and will not be considered for funding unless a project will result in a major improvement in the water quality of the receiving waters. This will be reflected in the priority points assigned to the project and will determine its relative ranking on the Project Priority List.

When it can be justified, based on a complete sewer system evaluation survey, that the reduction of groundwater infiltration and/or inflow is a cost effective solution but will not significantly affect the sizing of wastewater treatment facilities, then it may be considered for funding, however, it will receive a lower priority than those types of projects indicated above.

Projects for wastewater collection systems alone will have a lower priority than those mentioned above. In general, in order for collection systems to be eligible for Federal and State funding, the bulk (generally two-thirds) of the flow design capacity through the sewer system must be wastewaters originating from a community in existence on October 18, 1972 and the collecting sewers must be proven to be necessary and cost effective. Systems of collection sewers for new sub-divisions or newly developed urban areas shall not be eligible under the Construction Grants Program.

Project Priority List

A project priority list is an enumeration and ranking of potential municipal construction projects in the State. The priority list consists of a fundable list which shows the projects which can be funded under the available funds for FY83, from October 1, 1982 to September 30, 1983, and an extended list which shows projects planned for funding for FY84, FY85, FY86 and FY87.

The project list is derived from unfunded projects from the previous FY82 construction grants project list and from new applicants expressing an interest to be included for funding.

The projects are then ranked by assigning points on the basis of the criteria shown on Table A.

It should be noted under the section heading A. **Type of Project** that although several point values may apply to a specific project, only the highest value which pertains is applied. However, under the section heading B. **Effect on Uses** more than one numerical value can apply since it is possible that a project may have beneficial effects on more than one use for a particular waterway. The highest possible point value that can be obtained is 235.

The project priority list for FY83 will contain Step 3 construction projects and combined Step 2 and Step 3 projects for design and construction.

The Clean Water Act of 1977 together with the Municipal Wastewater Treatment Construction Grant Amendments of 1981 require certain changes to the Priority System including: a Project Bypass Procedure, provision for Additional Allotments, reserve for Alternative and Innovative Technologies, reserve for alternative systems for small communities, exclusion of Step 1 and Step 2 projects, reserve for Water Quality Management Planning, reserve for Step 1 and Step 2 advances for small communities. These changes are described as follows.

Project Bypass Procedure

A project on the fundable portion of the Project Priority List may be bypassed if the Division of Water Pollution Control determines that the bypassed project will not be ready to proceed during the funding year. Projects that are bypassed shall retain their relative priority rating for consideration in the future year allotments. Projects bypassed will be replaced by the highest ranked priority projects on the extended portion that are ready to proceed during the funding year.

Additional Allotments

The Division of Water Pollution Control upon receipt of additional Federal allotments, if any, may move projects from the extended portion of the priority list onto the fundable portion. The projects moved into the fundable range will be the highest priority projects on the extended portion ready to proceed.

Alternative and Innovative Technologies

The Clean Water Act of 1977 and the 1981 Amendments, require grant recipients after September 30, 1978 to analyse alternative and innovative treatment processes and techniques for use in wastewater treatment plants. The Act provides for grants of 85 percent of allowable construction costs for treatment works that use alternative and innovative treatment processes and techniques. The Division of Water Pollution Control is required to use 4 percent of the FY83 allotment to fund the incremental cost of increasing the Federal grant from 75 percent to 85 percent of alternative and innovative processes or techniques identified for funding by the DWPC. Wherever possible, projects anticipated to be eligible for increased alternative and innovative funding are indicated on the fundable list. A line item has been indicated to set aside the funds for projects using alternative and innovative processes.

If in the event requests for funding under alternative and innovative technologies exceed funds available in the 4 percent set aside, the DWPC will use the following criteria to select the projects to be funded:

1. The potential for beneficial use of the process or technology throughout the State in the future.
2. The relative priority of the project that will use alternative and innovative processes and techniques.
3. The date upon which the application for the project is submitted.

The DWPC must use the money set aside for innovative or alternative projects within one year after the end of the fiscal year or the money will be re-allocated to other states. Because of this, if there are insufficient projects on the fundable list to utilize the 4 percent set aside, projects on the extended list utilizing alternative and innovative processes may be re-ranked high enough to assure their place on the fundable list to provide for utilization of the funds.

Reserve for Alternative Systems for Small Communities

The Governor of Massachusetts has requested, and the Regional Administrator of EPA has agreed that Massachusetts be designated as a rural State. The Regional Administrator may authorize the State to reserve up to 4 percent of its allotments for funding alternatives to conventional treatment works for small communities. Small communities are defined as municipalities with a population of 3,500 or less or highly dispersed sections of larger municipalities.

The DWPC has attempted to list certain municipalities under the reserve for alternative systems for small communities which may use non-conventional treatment systems. Most of these communities are listed without the benefit of a completed facilities plan for DWPC review. If an approved facilities plan for a community listed indicates in the future that the community will utilize a conventional treatment scheme, then the project will be removed from the reserve list. The associated EPA money set aside will then be available on the fundable list for other projects consistent with the project bypass procedure indicated above.

Exclusion of Step 1 and Step 2 Federal Grants

The 1981 Federal Amendments do not allow grants to be made for the purpose of providing financial assistance solely for preparation of facility plans, plans/specifications, nor estimates for any proposed project for the construction of treatment works. In the event that a project receives a Step 3 Federal grant for construction, EPA shall make an allowance in such grant for non-Federal funds expended during preliminary and final planning.

Reserve For Water Quality Management

The 1981 Amendments also provide for a reserve of $100,000 or 1% of the allotment, whichever amount is greater, which would allow the States to carry out water quality management planning activities. This could include: determination of water quality problems in various areas of the state; and/or evaluation of state-wide pollution abatement programs.

Reserve For Step 1 and Step 2 Advances

Under the 1981 Amendments, a State can use up to 10% of its Federal allotment to advance funds to small communities for preliminary and final planning. However, only a nominal amount has been set-aside in Massachusetts for this purpose since the same goal can now be accomplished for any eligible community through the provisions of Chapter 286 of the Acts of 1982.

TABLE A
CRITERIA FOR RANKING
CONSTRUCTION GRANT PROJECTS

A. Type of Project	Points
1. Advanced Wastewater Treatment Project Required to Meet Water Quality Standards in Areas Where Secondary Treatment Technology is not Sufficient (Water Quality Limited Segments).	100
2. Waste Treatment Projects Where Secondary Treatment is Required (Effluent Limited Segments) or Primary Treatment Projects Where Secondary Treatment Waivers have been Obtained.	90
3. Projects that Utilize Alternatives to Conventional Wastewater Treatment Plants.	85
4. Outfall sewers, major intercepting sewers, major pumping stations, and force mains. (If constructed in conjunction with a wastewater treatment plant, these projects will have the same priority ranking as the treatment plant).	80

Exhibit 5-1 (continued

5. Correction of infiltration/inflow problems that are cost-effective and are needed to maintain the integrity of an existing or proposed wastewater treatment system project will receive the same priority ranking as the treatment system project. 100, 95 or 90
6. Projects for the Correction of Combined Sewer Overflows. 80
7. Correction of infiltration/inflow problems where study shows such corrections to be cost effective but will not significantly affect the sizing of wastewater treatment facilities. 75
8. Collection sewers which convey wastewaters to treatment works which presently provide adequate treatment. 40
9. Collection sewers which convey wastewaters to adequate treatment works presently under construction or where a Step III grant has been awarded. 30
10. Collection sewers which convey wastewaters to treatment works for which a Step II grant has been awarded for upgrading a treatment plant. 20
11. Collection sewers which convey wastewaters to treatment works which afford only primary treatment or are of inadequate capacity. Points will be awarded only if a form schedule has been established through an NPDES permit, State consent order, or three-party agreement such that, when the treatment works are completed all statutory and regulatory requirements will be met. 10
12. Collection sewers which fail to fit in categories 8-11 above. 0

B. Effect on Uses

	Slight	Moderate	Great
1. Project will improve or protect a freshwater drinking water supply	10	20	30
2. Discharge is presently causing health hazard or nuisance	10	20	30
3. Project will have beneficial effect upon fish and aquatic life	5	10	15
4. Project will have beneficial effect upon recreation	5	10	15
5. Project will improve or protect an industrial water supply	5	10	15

6. Existing Population Served
   - greater than 100,000 — 30 points
   - 50-100,000 — 20 points
   - less than 50,000 — 10 points

DEFINITIONS

NPDES Permit No.: National Pollutant Discharge Elimination System Number.

Needs Survey Number:

This is the unique number assigned in connection with the Needs Survey which identifies the facility. If a facility number has not been assigned, "NO NUMBER" is entered.

Project Step:
- Step 1 — facilities planning
- Step 2 — final design
- Step 3 — construction

Grant Certification Date: Date project is expected to be certified by DWPC to EPA for funding.

Project Description:
- WWTP — Wastewater Treatment Plant
- AWT — Advanced Wastewater Treatment
- CSO — Combined Sewer Overflow Treatment
- I/I — Infiltration/inflow
- Int. — Interceptor
- P.S. — Pumping Station
- F.M. — Force Main
- Sep. — Separation
- Inc. — Incineration

Alternative Systems for Small Communities: For Step 2, 3 or 2+3 projects, costing includes an alternative system for a small community. The letter "D" is used if the project is for a highly dispersed section of a larger community or "R" if the project is for a rural community with a population of 3,500 or less.

Enforceable Requirements:
- A— Project satisfies the conditions or limitations of a 402 or 404 permit which, if violated, could result in the issuance of a compliance order or initiation of a civil or criminal action under Section 309 of the Clean Water Act.
- B— Permit has not been issued but project satisfies a condition or limitation which would be included in the permit when issued.
- C— Permit is not applicable but project satisfies a requirement anticipated to be necessary to meet applicable criteria for best practicable waste treatment technology (BPWTT).
- D— Project does not meet an enforceable requirement of the Act.
- Y— The project in its entirety satisfies the enforceable requirements of the Act for the condition stated in the preceding character position.
- P— Portions of the project do not satisfy the enforceable requirements of the condition stated in the preceding character position.

Innovative Eligible Cost/Alternative Eligible Cost: For Step 2, 3 or 2+3 projects, that amount, if any, of the eligible cost to be applied separately to alternative techniques and innovative processes.

Eligible Cost by Needs Category:
For Step 3 or 2+3 projects on fundable list only:
- Category I—Secondary treatment
- Category IIA—AST portion
- Category IIB—AWT portion
- Category IIIA—Infiltration/inflow correction
- Category IIIB—Sewer system replacement or major rehabilitation
- Category IVA—New collectors and appurtenances
- Category IVB—New interceptors and appurtenances
- Category V—Correction of combined sewer overflows

Priority List/Water Quality Management Plan Relationship (WQWM Code):
1. State has an approved WQM plan and the project is consistent with the plan.
2. State does not have an approved WQM plan but the project is essential to correct an existing water quality problem.
3. State has an approved WQM plan but the project is not consistent with the plan.

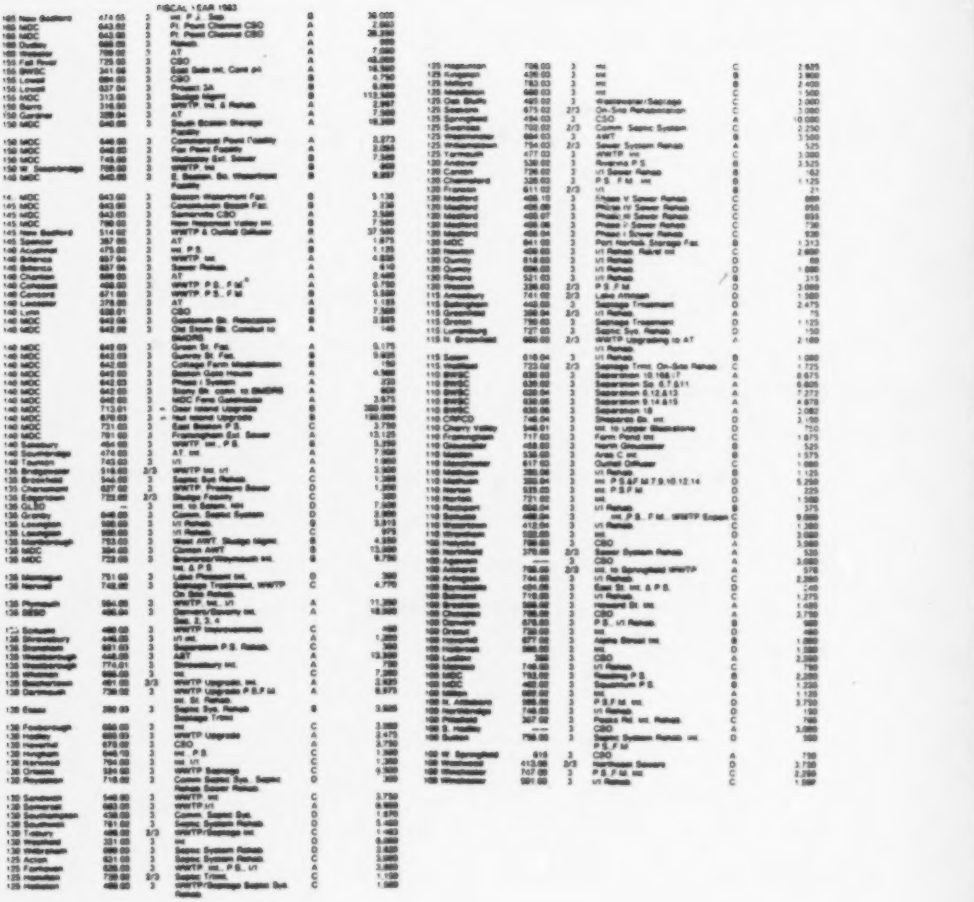
FISCAL YEAR 1983 FUNDABLE LIST SUMMARY

	$EPA FUNDS
Total Fundable List Projects	128,595,000.
Contingency/Increases	13,766,394.
Program Management	6,113,424.
Innovative/Alternative	6,113,424.
Water Quality Management	1,528,356.
Step 1 and 2 Reserve	2.
Total Funds Unobligated	$156,116,600.

FISCAL YEAR 1983 COMMONWEALTH OF MASSACHUSETTS
CONSTRUCTION GRANTS PROJECT PRIORITY LIST FUNDABLE PORTION

PRIORITY POINTS	APPLICANT	PROJECT NUMBER	PROJECT STEP	DESCRIPTION	ENFORCEABLE REQUIREMENTS	Est. EPA FUNDS (000)
165	New Bedford	474.04	3	Int., P.S., Plant Improve. Grit Chamber	B	$7,800
160	Hatfield	285.03	3	WWTP, Int.	A	2,722
155	BWSC	341.05	3	Contract 3	B	24,600
155	Lowell	637.03	3	Project 3	B	6,000
150	Dighton	480.03	3	Int., P.S.	B	1,737
150	MDC	640.02	3	Foxpoint CSO	A	2,063
150	Taunton	479.03	3	Int., P.S.	A/	1,794
145	Beverly	398.05	3	Bass River	A	3,525
145	MDC	643.02	3	Constitution Beach	A	236
145	Milford	309.02	3	AWT	B	10,000
145	Russell	432.02	2/3	WWTP, Int., I/I Rehab.	A	980
145	Winthrop	687.02	2/3	Priority, One Int., P.S.	C	1,200
140	CRWPCD	467.03	3	Black Swamp Int.	A	1,300
140	Hudson	388.03	3	WWTP expan.	A	4,500
140	MDC	642.02	3	Stony Brook Int.	A	1,103
140	MDC	642.02	3	St. Mary's CSO	A	295
140	Millis	465.03	3	Int., P.S.	A	3,000
140	Stockbridge	431.02	2/3	WWTP, Int.	A	3,750
140	Williamstown	609.03	3	Int.	B	678
140	Worcester	347.06	2	Cont. 4/5, 11	A	8,500
135	Abington	483.03	3	Int.	B	900
135	Ashfield	526.02	2/3	Comm. Septic System	A	470
135	Clinton	649.02	2/3	I/I Rehab.	B	72
135	Falmouth	326.02	2/3	I/I Rehab.	B	240
135	Falmouth	326.03	3	WWTP, Int. P.S., F.M., I/I	B	12,000
135	MDC	646.05	3	Mattapoisett Valley Int.	B	4,650
135	Montague	708.03	3	CSO	A	1,200
135	Nantucket	473.03	2/3	WWTP-Surfside & Siasconset	A	4,800
135	SESD	458.03	3	Sect. 3E Int.	A	750
135	Stoneham	681.02	2/3	I/I Rehab., Sep.	C	380
130	Athol	382.03	3	WWTP Improvements	A	1,200
130	Comm. of Mass.	547.01	2/3	Int., P.S., I/I Medfield State Hosp	B	339
130	Longmeadow	375.02	3	Int.	C	1,980
130	MDC	529.03	3	Rutland-Holden Int.	B	3,585
130	Quincy	406.03	3	Faxon Park P.S. Int.	C	3,940
130	Templeton	654.01	2/3	WWTP Upgrade	A	618
130	Walpole	415.03	3	Int. I/I, Septage	A	2,300
130	Wellesley	598.03	3	I/I, Int.	C	2,700
130	Wilbraham	699.02	2/3	Int. to Springfield	A	750

Exhibit 5-1 (continued)



One major planned project is upgrading Deer and Nut Islands, the MDC sewage treatment plants in the Boston Harbor. This pollution-abatement project has already cost over $149 million for planning, design, and construction of new pollution-abatement facilities; another $19 million for construction and $12 million for planning and design will be spent this fiscal year. In the next three years, $177 million will be spent on planning or construction of projects in the Boston Harbor area. However, the estimated need for the total clean-up effort is $848 million, of which just $588 is likely to be allocated by the EPA to the state as a whole over the next ten years (Massachusetts DEQE, Memorandum: Boston Harbor Cleanup, February 1983).

In addition to the need to clean up Boston Harbor, which is jeopardized by reductions in funding from the EPA, the EPA itself publishes an annual assessment of the costs necessary for the states to comply with the Clean Water Act. The 1982 EPA needs assessment is based on data provided by the Division of Water Pollution Control of the DEQE. This survey concludes that Massachusetts has a backlog of $4.7 billion in construction needs, in categories as shown in Table 4-9.

For example, according to the Northern Middlesex Regional Planning Commission (NMRPC):

> the major physical need of the regional treatment system is treatment of combined sewer overflows which currently exist and will continue to exist. Since the system is a combined one, storm events necessitate direct discharges of sewage into the [Merrimack] river in order to relieve the plant of excessive flows. A study of treatment methods is currently underway (memorandum from Robert W. Flynn, April, 1983).

The NMRPC estimates that the cost to correct or treat the CSO

Table 5-2

1982 EPA Assessment of Backlog Costs, in Millions of 1982 Dollars

Category of Backlog	Dollars
Secondary Treatment	$1,233
Advanced Secondary Treatment	85
Advanced Treatment	17
Infiltration/Inflow Correction	20
Major Sewer System Rehabilitation	18
New Collectors and Appurtenances	806
New Interceptors and Appurtenances	574
Correction of Combined Sewer Overflows	1,990
Total	$4,743

Source: 1982 EPA needs survey, Table 1, p. 43. Estimates of cost of providing treatment services to the 1980 population as estimated by the 1980 U. S. Census for abatement of existing pollution problems.

problem in Lowell could be as high as $80 to 90 million.

Construction Plans

The EPA plans to reduce the amount of funding available to the states for water-pollution control. This would severely impede the progress of the state towards its goal of providing safe waters that both protect the health and safety of the citizens, and increase recreational uses of rivers, lakes, and streams, which contribute to the economic vitality of the state's tourist industry. EPA estimates (Table 4-10) that the state will need to spend over $3 billion for sewers and treatment just to accommodate population growth needs by the year 2000; nearly $8 billion for all waste-water needs (Tables 4-9 and 4-10).

Sewage Collection Systems

The estimates for new collectors and appurtenances shown in Tables 4-9 and 4-10 are the major indicators available of the cost of the construction needs of local sewerage systems. The need is estimated at $806 million in 1982 and $885 million in 2000.

Existing Facilities and Age

The major available physical measurements of sewerage lines are from the MDC. This system maintains 277 miles of trunk sewers, with more under construction as part of the MDC's program to improve and extend the system and provide overall pollution control. Over 5,345 miles of local sewage collection lines flow into MDC trunk sewers, with 415,177 house connections (MDC, 1981). The MDC Sewerage Division has 10 pumping stations, two treatment plants, four pretreatment headworks, a detention and chlorination station for combined stormwater and sewage overflows along the Charles River Basin.

Forty-three cities and towns covering 406 square miles with

Table 5-3

1982 Estimates of Year 2000 Needs, in millions of 1982 dollars

Category of Backlog	Dollars
Secondary Treatment	$1,375
Advanced Secondary Treatment	98
Advanced Treatment	23
Infiltration/Inflow Correction	20
Major Sewer System Rehabilitation	18
New Collectors and Appurtenances	885
New Interceptors and Appurtenances	740
Correction of Combined Sewer Overflows	na
Total	$3,259

Source: 1982 EPA Needs Survey, Table 21, p. 63. These estimates address treatment needs, including those of new growth areas, for projection population of the year 2000. The projected population of Massachusetts in 2000 is 6.7 million, based on Bureau of Economic Analysis projections (Table 32, p. 74).

2,185,855 inhabitants and a contributing population of 1,881,805 are members of the MDC Sewerage District. Per capita cost of sewerage operations in 1981 was $11.69, of which $7.40 was spent on maintenance and opefation and $4.29 on debt service (MDC, 1981). Average daily sewage load was 379 million gallons and the 24-hour maximum flow was 716 million gallons per day passing through primary treatment and chlorination at Deer Island and Nut Island plants before discharge by outfalls into outer Boston Harbor (MDC, 1981).

Of the 351 towns and cities in the state, 153, or about 44 percent, have no central sewer system. There is no information available on the proportion of these 153 nonsewered communities that need a sewerage system but cannot afford to build one (derived from Massachusetts Division of Water Pollution Control, 1980). Some of that information could be obtained from the 208 plans, drawn up in the 1970s.

Only two regional planning agencies, the Old Colony Planning Council (OCPC) and Southeastern Regional Planning and Economic Development District (SRPEDD) provided detailed information on the sewerage systems in their regions.

In the OCPC district, information is available for the Brockton, Bridgewater, Plymouth, Stoughton, Abington and West Bridgewater sewerage systems (see Table 4-11). The rest of the OCPC communities rely on private, on-site underground septic systems (this section is based on OCPC, 1983).

Brockton is sewered and rates its system as fair, but one area of the city (Ward 6) has a "substantial" water infiltration problem. Funding to replace pipe in that area is tied in with reconstruction of a new Brockton sewage treatment facility.

Table 5-4

Sewage Systems in Selected Cities and Towns

Community	Percent Sewered	Self-Rating	Age of System
Abington	"small area"	(tied to Brockton system)	
Attleboro	na	good	na
Brockton	100	fair	
Bridgewater	town center; college; schools	poor to fair	
Fall River[1]	na	poor	na
Marion[2]	na	poor-good	1905
Middleborough	na	good[3]	"new"
New Bedford	na	poor to excellent[4]	
Plymouth	25 percent	fair	
Stoughton	51 percent	fair to good[5]	
Taunton	na	poor	na
West Bridgewater	"small area"	(tied to Brockton system)	

Source: OCPC and SRPEDD staff reports; MIS questionnaire

Note: na = not available

1 Fall River needs to separate storm and sanitary sewers, and to expand pump station in industrial park, but does not have the money to do it.

2 Need to replace several areas' collection system; this money has been allocated by Town Meeting

3 Being upgraded; need to extend sewer to growth area. Cost of this is estimated at $1.5 million, and grant request was rejected.

4 Upgrading of collection system underway, and some CDBG funds are budgeted to stop deterioration, but "cannot keep up." Proposition 2 1/2 "does not allow enough revenue."

5 Physical condition of system is deteriorating. User charges cover operation of sewage treatment plant, but Proposition 2/12 restricts maintenance. Not enough money is budgeted to stop deterioration. New sewer lines are needed in North Taunton; federal and state funding is being pursued.

Bridgewater's town center, Bridgewater State College, and other schools are sewered, and this system was rated poor to fair. They hope to expand their old plant to double the present flow capacity of 1.5 mgd and upgrade it from secondary to tertiary treatment.

Plymouth is about 25 percent sewered, and the system was rated fair. Stoughton is 51 percent sewered, with a rating of fair to good. Both Abington and West Bridgewater have small areas contiguous with the Brockton town line that are tied in with the Brockton system (above from SRPEDD response to Massachusetts Infrastructure Study questionnaire).

Needs

In the suburban communities of the Northern Middlesex RPC, sewer extensions to include additional areas of the town in the distribution and treatment system are generally the major needs. The cost of sewer extensions in the suburban communities were estimated, in 1978, to be (Robert W. Flynn, April, 1983):

Dracut	$20,000,000
Tewksbury	44,000,000
Tyngsborough	6,700,000
Chelmsford	8,160,000

In Lowell, the needs of the sewerage collection system was estimated by the NMRPC at $3 to 5 million annually. No other information was provided by other regional planning commissions.

Construction Plans

The NMRPC provided the following expansion plans for towns and cities in that area. In Billerica, a facility plan is underway to upgrade the level of treatment and expand coverage of the system. In

Dracut, the second phase of sewerage-system planning is now underway, and construction is expected to begin next year. In Tyngsborough and Pepperell, the second phase of sewerage-system expansion is currently in design, and construction is expected in one to two years in Pepperell and two to three years in Tyngsborough. In Lowell, a major interceptor is half constructed and the other half is in final design. A combined sewer study is underway, with construction expected over the next five to seven years. No other information was available from the regional planning commissions for other localities in the state.

HAZARDOUS WASTE

According to state law, hazardous waste is:

> a waste, or combination of wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness or pose a substantial present or potential hazard to human health, safety, or welfare or to the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. . . (Massachusetts General Laws of the Commonwealth. 1979. Chapter 21 C).

In 1979, the Massachusetts legislature passed Chapter 21C, which gave the DEQE broad authority to regulate hazardous waste activity. In 1982, Chapter 21D established a Hazardous Waste Facility Site Safety Council to determine the needs for new facilities. In March 1983 Chapter 21E established a $25 million bond fund so that the state can take remedial actions where parties responsible for spills or uncontrolled sites cannot be identified or do not have sufficient resources to pay cleanup costs. In addition, Chapter 21E gives DEQE substantial authority to exact corrective actions by assessing treble

damages and establishing liens. These three laws form the framework within which the Massachusetts Hazardous Waste infrastructure can be assessed.

Existing Facilities

Massachusetts currently has limited capacity to process the hazardous waste that is generated in the state. Of the approximately 190,000 tons of waste reported to be generated annually in the state, only about 30 percent is treated in Massachusetts. The remaining 70 percent is exported to out-of-state facilities for treatment, storage, and disposal. If waste oil is excluded from the reported waste, approximately 83 percent is transported out of state, primarily to the neighboring states of New York, New Jersey, and Connecticut (most of the information in this section is from Massachusetts Department of Environmental Management, 1982).

The 190,000 figure represents a minimum estimate; some transporters may not be submitting any or all of their monthly hauler reports, and some generators may not be using licensed transporters. However, the extent of illegal disposal is unknown (Mass. DEM, 1982).

As of late February 1983, there were 38 existing, licensed facilities for off-site treatment and storage of hazardous wastes. In addition, there were 330 "interim status facilities," mostly at the site of generation. A listing of these facilities can be found in Massachusetts DEQE, Division of Hazardous Wastes (undated, untitled memorandum).

Five licensed solvent recovery facilities can process a total of 25,000 tons per year; one facility can incinerate some organic liquids and neutralize some caustic aqueous wastes; several large generators

have their own on-site treatment facilities. However, only one of these firms has any treatment capability other than oil or solvent recovery, and this one cannot treat aqueous solutions containing large quantities of heavy metals (Mass. DEM, 1982).

There are approximately 160 transporters licensed to transport hazardous waste in Massachusetts (Mass. DEM, 1982).

Needs

To safely treat and dispose of hazardous waste generated in Massachusetts, the state would need the following additional facilities, according to Mass. DEM (1982):

1. Two solvent recovery facilities, each capable of treating 20,000 tons per year;
2. At least one 50,000 ton per year aqueous treatment facility (the need for more than one aqueous treatment facility is dependent on the extent of waste pretreatment undertaken by Massachusetts generators);
3. Approximately an acre of landfill per year; and
4. One rotary kiln incinerator capable of handling at least 22,000 tons per year with a potential requirment of 31,000 to 52,000 tons per year.

Construction Costs

There are no estimates of construction costs for hazardous waste facilities.

SUMMARY

The current and expected revenues and expenditures on wastewater infrastructure are presented in Table 5-5. Given the information available at this point, it appears that expected revenues from all governmental

Table 5-5

SUMMARY OF CAPITAL INVESTMENT NEEDS
AND REVENUES IN MASSACHUSETTS
(millions of 1982 dollars)

Wastewater

Needs for Selected Periods	
Period	1983-2000
Total Need	$5,100[a]
Average Annual Need	$280
Need to Year 2000	$5,100
Average Annual Expenditures[o]	$28
Total Expected Revenue to Year 2000[p]	
Total	$2,331
Federal	$1,494
State	$504[b]
Local	$333[c]
Expected Revenue Minus Expected Need to Year 2000	$-2,769

SOURCE: Refer to Table 6-1.

[a]Based upon EPA needs survey to the year 2000, including combined sewer overflow capital requirements, which are no longer eligible for federal funds.

[b]Based upon current state general revenue-bond requirements.

[c]Assumes continuous proportion two-thirds of state for capital projects.

sources may fall short of anticipated needs by as much as $2,769 million by the year 2000. A more detailed discussion of these estimates is provided in Part 6.

31-895 O - 84 - 11

Part 6

SUMMARY OF NEEDS AND REVENUES: MASSACHUSETTS

Table 6-1 presents a summary of anticipated needs and revenues for infrastructure capital within the Commonwealth of Massachusetts to the year 2000. The reader is urged to use this table with extreme caution and to pay particular attention to the footnotes to each of the entries in the table. The research staff have attempted to summarize the capital requirements for the state by individual categories, using the best available data for the near term. In some instances, needs data were available for two to five years into the future, while in other cases, data were available for even shorter time periods. In still other circumstances, accurate data were available for project needs, but the timing was uncertain. Actual revenue data were obtained for fiscal 1982 only.

NEEDS

For highways, only relatively subjective data were available for needs, though considerable data were available in a number of forms for projects requiring attention and for expected annual levels of federal funds available for project implementation. The major highway project under consideration at the present time is the depression of the central portion of the Central Artery. This project could not be included in the table at the time of writing (May 1983), because no firm cost estimates were available.

Bridge projects within the state offered one of the more concrete sets of numbers because it is unlikely that any new bridges will be built at new locations. As a result, there can be a relatively accurate estimate of annual maintenance requirements.

There is only one tunnel project under consideration and that is the

Table 6-1

SUMMARY OF CAPITAL INVESTMENT NEEDS AND REVENUES IN MASSACHUSETTS
(millions of 1982 dollars)

Investment	Needs for Selected Periods: Period	Needs for Selected Periods: Total Need	Average Annual Need	Need to Year 2000	Average Annual Expenditures[o]	Total Expected Revenue to Year 2000[p]: Total	Federal	State	Local	Expected Revenue Minus Expected Need to Year 2000
Highways, Bridges, and Tunnels										
Highways	1983	300[a]	250-350	5,400						
Bridges	1980-2000	1,000[b]	50	900	100	9,458-9,818	5,858[q]	3,600-3,960	n.a.	2,158-2,518
Tunnels	--	1,000[b]	--	1,000			[3,339][r]			
Railways	1983-1987	220[c]	43	780	9	162	n.a.	n.a.	n.a.	(518)
Public Transportation										
MBTA	1983-1987 (1993)[d]	1,400-1,600	150-400	2,700-7,200	70	1,260	n.a.	n.a.	n.a.	(1,440)-(5,940)
Other	1983-1988	28[e]	5-6	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Airports[f]										
Logan	1983-1988	550[g]	110	2,300	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other	1983-1984	12[h]	5	90	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Seaports[m]										
Boston		[i,n]								
Other										
Water Supply	1983-1990	520[j,k]	65	1,150	17	306	--	306	n.a.	n.a.
Wastewater	1983-2000	5,100[m]	280	5,100	28	2,331	1,494	504[s]	333[t]	(2,769)
TOTAL			958-1,309	19,520-24,020	n.a.	n.a.				

SOURCE: Summary of needs presented in various sections of this report. Sources of data are provided in each section.
Figures in ( ) are negative.

Notes to Summary Table of Capital Investments

n.a. - not available

[a]Based upon current needs independent of availability of federal funds. Does not include depression of the central portion of the central artery currently under consideration.

[b]Boston harbor third tunnel estimate of $1 billion.

[c]Based upon 1983 to 1987 commuter rail investment plan ($200 million) plus estimate of annual expenditures on grade crossings.

[d]Represents total proje needs. Timing uncertainty reflects both ability to implement projects and likely flow of federal funds.

[e]Based upon 5-year plans (RTA) for replacement of bus fleet and other system rehabilitation.

[f]Total dollar requirements of which federal share is expected to remain at 90 percent.

[g]Does not include estimated/planned expansion program of $300 million for new runway, new cargo terminal, new commercial complex, etc.

[h]Includes $2 million for renovation of Westfield airport as well as estimated annual capital requirements.

[i]Includes $43 million in 1983 for Phase 3 of the Boston Harbor Plan. Includes South Boston container facility development.

[j]Calculation based on maintenance of safe yield and guarantee of 150 to 200 gallons/capita/day. (The EPA standard is 100 gpd; over estimate accounts for distribution within state and for annual variations.) The present system's yield of 215 gpd is for 87 percent of population. If 90 percent of population (6.7 million) served in 2000, then require a maximum of 131 MGD safe yield additional supply. Supply estimates are $2 million/MGD or $260 million.

[k]Includes estimated $357.5 million over 10 years for water-supply improvements under Chapter 286.

[m]Based upon EPA needs survey to the year 2000, including combined sewer overflow capital requirements, which are no longer eligible for federal funds.

[n]Seaport data not available at time of table preparation.

[o]Average Annual Expenditures is based on identifiable annual infrastructure project expenditures contained within the Massachusetts state budget and upon annual interest and principal charges paid for project bonds.

[p]Assumes revenue stream is constant for 18 years.

Notes to Summary Table of Capital Investments (continued)

[q]Represents Department of Transportation obligated funds through the year 2000.

[r]Identifies portion of obligated funds actually utilized, based upon historical trends, for earmarked projects.

[s]Based upon current state general revenue-bond requirements.

[t]Assumes continuous proportion two-thirds of state for capital projects.

Third Harbor Tunnel Project. While the final decision on proceeding with construction of the tunnel has not been made, cost estimates appear firm; therefore, the costs of the project have been included in this summary.

For the MBTA, a detailed list of future need-based projects is available with relatively accurate estimates of their total costs. The time horizon is less certain, as reflected in the table. As a result, the projects were estimated to be completed over an 8-year period.

Environmental infrastructure projects were more difficult to estimate than other of the projects. As will be seen from the table notes, water-supply requirements are uncertain. In general, Massachusetts is not in a severe deficit position with respect to water supplies, but is in need of additional capital for maintenance and refurbishment of distribution systems. The Commonwealth has begun a capital-expensive program for refurbishment of supply systems. These figures are included in the table.

Wastewater capital requirements are based upon requirements set by the federal government and enumerated in the annual survey. The research team has added the combined sewer overflow requirements to the other waste-water capital requirements, as these represent a major need in Massachusetts.

Both airports and seaports present special problems in Massachusetts. Air and sea commerce focuses on Boston. Those facilities have therefore been separated from the remainder of state facilities. Logan airport has a clear plan for maintenance of the capital stock for the next five years. This has been included in the table. In addition, there is a plan for significant expansion of the airport facilities. These have not been included in the table. The other airports in the state are of less commercial significance, but will require attention during the period to the year 2000.

It has been difficult to estimate the capital requirements for seaport

facilities in the Commonwealth. Boston Harbor is in the midst of a major renovation process, which includes expansion of specific facilities--container port facilities--and essentially elimination through abandonment of privately held traditional dock facilities. The capital development needs of the port and the new container facilities have been included in the estimates, but any other port-related commercial development has not been included.

As a final caveat, the reader should see this summary table as a relatively clear picture of the capital requirements for the next few years. For specific sectors, the picture is more clear out five to ten years. Beyond 1990, however, the picture is clouded at best. To estimate future capital requirements to the year 2000, it was necessary to assume that the annual requirements will remain constant, an assumption with which the staff members were extremely uncomfortable, yet one that was necessary to create at least a first approximation of the overall capital requirements to the turn of the century. In defense of the procedure, only one relatively weak argument can be made, and that is that Massachusetts is not expected to see significant growth in population to the turn of the century. Incomes, as well as high-technology and service jobs, are expected to grow in the Commonwealth in the next two decades. But these increases are unlikely to place dramatic growth requirements on the infrastructure in the state. Instead, demands will be placed upon the reliability and service of the infrastructure.

REVENUES

The Governor must, by law, submit a balanced budget. Thus, all agency expenditures must be limited to the anticipated level of revenues. The proposed FY1984 budget totals $7.36 billion, 8.3 percent larger than FY1983 revenues and 7.8 percent larger than FY1983 appropriations. Of the total

budget, approximately 1.9 percent or ($140 million) represents recommendations for the Executive Office of Environmental Affairs, which is responsible for the construction and maintenance of sewer, water, wastewater, hazardous, and solid waste facilities. Another 4.5 percent (or $329 million) represents recommendations for the Executive Office of Transportation, which is responsible for the construction and maintenance of the state's bridges, highways, tunnels, public transit, and rail facilities. (These figures do not include federal funds such as the Federal Capital Improvements Fund and the Federal Highway Construction Fund.) When combined with the expected FY1983 surplus of $57.2 million, the total amount of financial resouces expected to be available for FY1984 are $7,397.4 million.

State revenues are generated from three major sources: taxes and excises, federal reimbursements, and departmental revenues.

About 74 percent or $5,521 million of the state's revenues are expected to be generated through taxes and excises. Of this projected total, $131 million are expected to result from the Revenue Enforcement and Protection Program, a new initiative intended to improve revenue collection.

The second largest source of revenues is federal reimbursement. Reimbursements are expected to total $1,089.6 million or 15 percent of FY1984 revenues. The reimbursements, which finance state expenditures for programs for which the federal government bears a portion of the cost, have declined in response to changes in federal laws pertaining to aid to states. In FY1984, federal reimbursements are expected to be $64 million less than they would have been under previous reimbursement formulas. Federal grants, which are distinct from reimbursements, are expected to be reduced by $77 million in FY1984. Therefore, the total reduction in federal receipts for the upcoming year is expected to exceed $141 million.

The third largest source of state revenues is departmental revenue, or fees charged by operating agencies for services rendered, including assessments for services to cities, towns, and districts. Departmental revenues are expected to reach $714.2 million or 9 percent of anticipated state revenues. More than $73 million are expected to result from the new revenue collection measures.

The remaining 2 percent or $15.5 million is expected to be generated through interfund transfers from nonbudgetary funds, that is, revenues that are not part of the general appropriations process and do not relate to any line-item recommendation in the budget. The nonbudgetary funds are created to receive revenues generated through state borrowing or bond issues. The funds include the Federal Highway Construction Program Fund and the Federal Capital Improvements Fund by which capital programs are financed through a combination of state borrowing and federal reimbursements; and the Freight Rail Fund and the Passenger Rail Fund by which the acquisition, preservation, reconstruction, and other improvements to rail facilities and equipment are financed.

The Commonwealth has the authority to issue debt, or to borrow, in order to finance legislatively approved capital projects. The Commonwealth issues three types of debt: general obligation debt, contingent liability debt, and guaranteed debt. General obligation debt consists of direct debt used to finance highway and pollution projects, district debt used to finance Metropolitan Sewer and Water Districts, and transit debt used to finance MBTA deficits. Contingent liability debt arises from statutory obligations for state payment of working capital and debt service of the MBTA and other regional authorities. Guaranteed debt consists largely of liabilities arising out of State guarantees of the obligations of local housing authorities and

higher education building authorities.

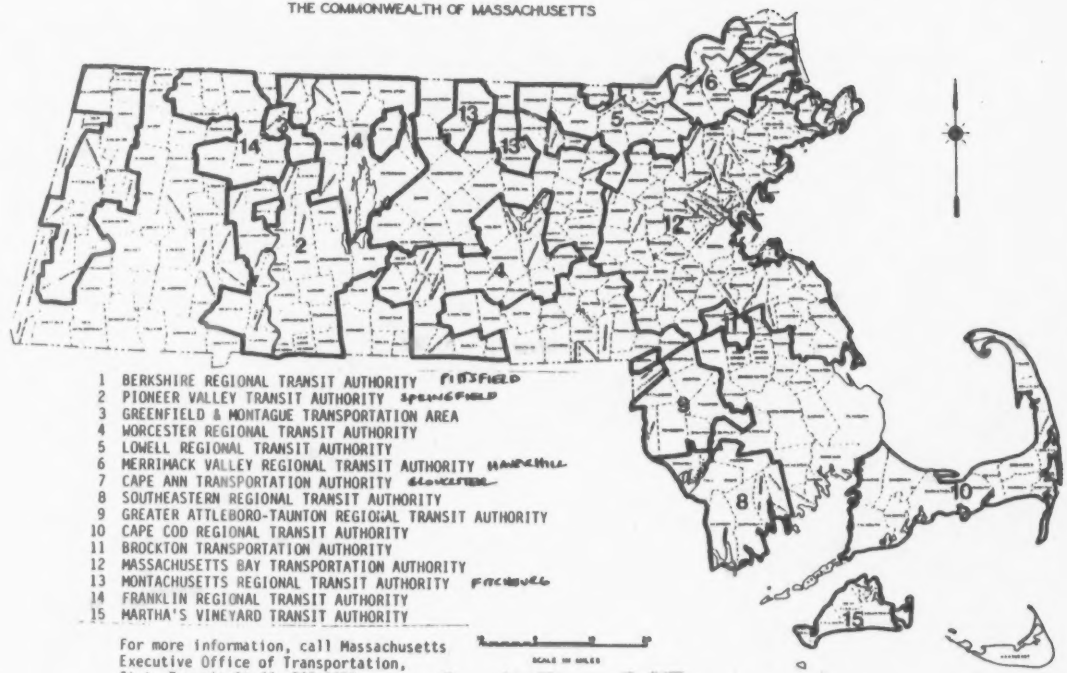
The revenues raised by the state are credited to several funds from which expenditures are made. The Operating Fund receives about two-thirds of the revenues, and funds all strictly state functions. The General Fund and the Highway Fund are two such funds. The Local Aid Fund receives about 40 percent of all taxes and funds all payments (except those made by the General and Highway Funds) made to cities, towns, and districts. The Assessments Funds are used to provide asssessments to cities and towns that benefit from services provided by the state. Among the Assessment Funds are the Metropolitan District's Water and Sewer Funds. There is also a General Federal Grants Fund which receives all federal grant monies obtained by any state agency. All federal grant funds must be distributed through this fund. There are, apparently, no comprehensive sector-specific fund-raising efforts. (Source: Executive Budget Recommendations, 1984, pp. I-2 and IV-2.)

As indicated in Table 6-1, the revenues do not meet the needs either for the current period or for the future. The potential variability of future federal aid and the preliminary nature of these estimates must be stressed.

APPENDIX A

Massachusetts Regional Transit Authorities

THE COMMONWEALTH OF MASSACHUSETTS



1 BERKSHIRE REGIONAL TRANSIT AUTHORITY PITTSFIELD
2 PIONEER VALLEY TRANSIT AUTHORITY SPRINGFIELD
3 GREENFIELD & MONTAGUE TRANSPORTATION AREA
4 WORCESTER REGIONAL TRANSIT AUTHORITY
5 LOWELL REGIONAL TRANSIT AUTHORITY
6 MERRIMACK VALLEY REGIONAL TRANSIT AUTHORITY HAVERHILL
7 CAPE ANN TRANSPORTATION AUTHORITY GLOUCESTER
8 SOUTHEASTERN REGIONAL TRANSIT AUTHORITY
9 GREATER ATTLEBORO-TAUNTON REGIONAL TRANSIT AUTHORITY
10 CAPE COD REGIONAL TRANSIT AUTHORITY
11 BROCKTON TRANSPORTATION AUTHORITY
12 MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
13 MONTACHUSETTS REGIONAL TRANSIT AUTHORITY FITCHBURG
14 FRANKLIN REGIONAL TRANSIT AUTHORITY
15 MARTHA'S VINEYARD TRANSIT AUTHORITY

For more information, call Massachusetts Executive Office of Transportation, State Transit Staff, 727-2373.

SCALE IN MILES

Source: Executive Office of Transportation and Construction

APPENDIX B

RTA Facility Survey

Please provide EOTC with the following information for buildings, land and other facilities currently used or needed by the RTA. EOTC needs the data to aid in statewide capital and infrastructure planning. Please use extra sheets and attach additional useful information as appropriate. Please complete a separate form for each of the following facilities.

1. Existing garage/maintenance facilities
2. Other existing facilities (transfer stations, offices, parking areas, etc.)
3. Needed facilities

RTA: _____

Name of facility: _____

Location: _____

Land Area: _____

Building site/square footage: _____

_____

Vehicle storage area - open/enclosed: _____

_____

Owned/Leased: _____

Functions/facilities provided: _____

_____

Condition: _____

Repairs or alterations needed/cost estimates: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Appendix C

MASSACHUSETTS INFRASTRUCTURE STUDY, 1983: QUALITY OF INFORMATION AVAILABLE

	Physical	Age	Quality	Cost		Needs	Plans
				Construction	Maintenance		
Buses							
Boston							
No. of routes	G	--	--	--	--	--	--
No. of buses	G	G	F	G	F	F	P
No. of garages	G	P	P	F	P	F	P
Other Areas							
No. of buses	G	G	G	G	P	F	P
Rapid Transit/Green Line							
Miles of track	G	n.a.	n.a.	n.a.	n.a.	P	P
Bridge track miles	G	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
No. of Stations	G	P	P	F	P	F	F
Route miles	G	--	--	--	--	--	--
No. of cars	G	G	P	F	P	F	F
Car houses, yards mileage	G	P	P	n.a.	n.a.	P	P
Trackless Trolleys							
Boston							
No. of routes	G	--	--	--	--	--	--
Route miles	G	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vehicles	G	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Commuter Rail							
Track miles	G	G	G	P	P	G	G
Route miles	G	--	--	--	--	--	--
Crossings	G	n.a.	P	G	P	F	F
Overhead bridges	G	n.a.	n.a.	F	n.a.	F	F
Underground track bridges	G	n.a.	n.a.	F	n.a.	F	F
Stations	G	n.a.	n.a.	F	n.a.	F	F
Vehicles	G	n.a.	n.a.	F	n.a.	F	F

Appendix C (continued)

	Physical	Age	Quality	Cost		Needs	Plans
				Construction	Maintenance		
Railways (State-owned)							
Grades and crossings	G	P	F	G	G	P	P
Bridges and tunnels	G	P	G	P	P	P	P
Highway Bridges	G	G	G	G	G	F	P
Airports							
Logan	G	F	G	G	P	P	F
Other 50	F	F	F	F	F	P	P
Seaport Facilities							
Boston	G	F	F	G	G	G	G
Fall River	P	P	F	P	P	P	P
New Bedford	P	P	P	P	P	P	P
Highways							
State	G	P	F	P	P	P	P
Local	G	P	P	P	P	P	P
MDPW	G	P	F	P	P	P	P
Turnpike	G	G	F	P	P	P	P
Tunnels	F	G	F	F	F	F	P
Water							
Supply	G	G	G	F	G	F	G
Distribution	P	G	F	P	F	P	P
Sewer							
Treatment plants	F	G	G	F	P	G	P
Pipes (collection)	P	P	P	P	P	P	P

Appendix C (continued)

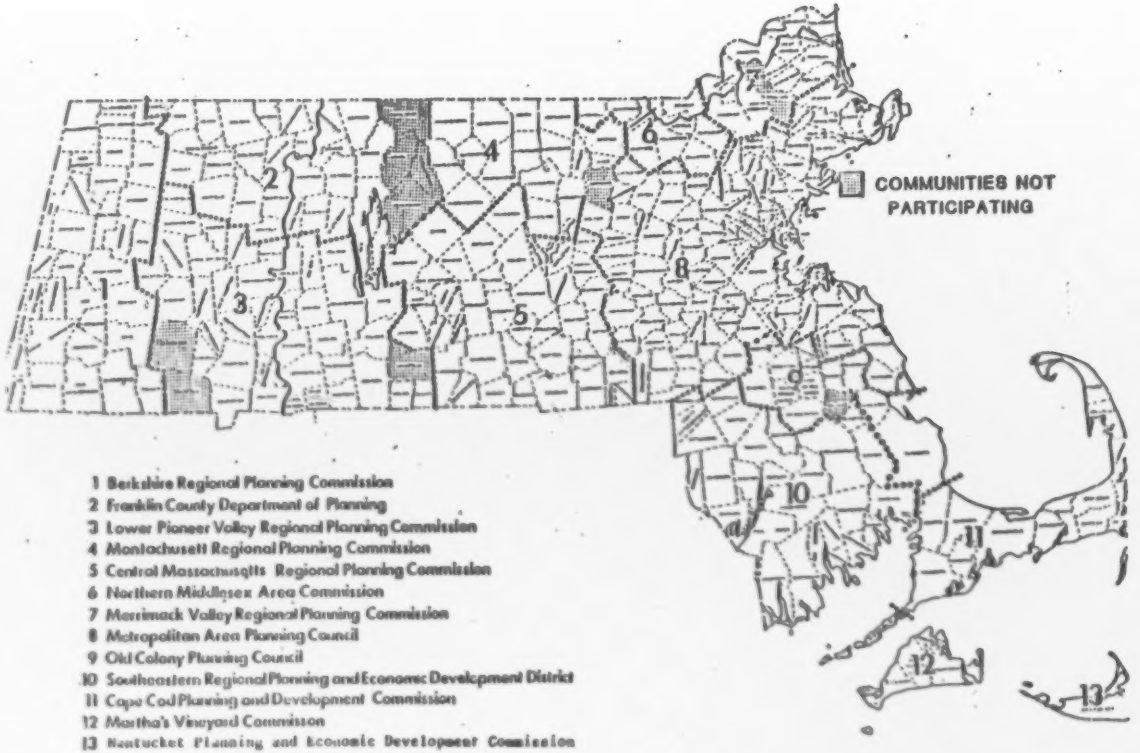
	Physical	Age	Quality	Cost		Needs	Plans
				Construction	Maintenance		
Hazardous Waste							
Treatment facilities	G	F	P	n.a.	n.a.	F	P

P = poor
F = fair
G = good
MDPW = Massachusetts Department of Public Works
-- = not applicable
n.a. = not available

SOURCE: Judgments made by research staff as to quality of data collected.

APPENDIX D

Regional Planning Districts


COMMUNITIES NOT PARTICIPATING
1 Berkshire Regional Planning Commission
2 Franklin County Department of Planning
3 Lower Pioneer Valley Regional Planning Commission
4 Montachusett Regional Planning Commission
5 Central Massachusetts Regional Planning Commission
6 Northern Middlesex Area Commission
7 Merrimack Valley Regional Planning Commission
8 Metropolitan Area Planning Council
9 Old Colony Planning Council
10 Southeastern Regional Planning and Economic Development District
11 Cape Cod Planning and Development Commission
12 Martha's Vineyard Commission
13 Nantucket Planning and Economic Development Commission

APPENDIX E

INTERVIEW GUIDELINES
MASSACHUSETTS INFRASTRUCTURE STUDY
February 14, 1983

Type of Infrastructure_____

I. Background, history of the problem/system.

Get information pertinent to this study--history of development, some idea of the constraints under which the system operates.

II. Current Condition.

A. What is there in terms of the following:

1. Physical Plant?

2. Economic function within Commonwealth (only if available)?

3. Current annual maintenance expenditures

a. Most recent year?

b. Average annual increase or decrease (past 10 years)?

c. What is budgeted for 1984?

4. What is past capital investment? What is system worth?

B. What are the perceived present needs to keep the system at or to bring it up to "required" standards of performance?

1. Physical?

31-895 O - 84 - 12

2. Capital costs?

   a. Expected expenditures?

   b. Expected/needed revenues?

C. Upgrade/Deterioriation

   1. What is the physical condition of the system?

   2. Is the system being upgraded or is it deteriorating? At what rate?

   3. What would be the minimum investment necessary to stop deterioration?

   4. What would be the minimum investment necessary just to maintain the status quo?

   5. What is the fiscal capacity required to stop deterioration?

a. Is money to stop deterioration budgeted?

b. What are the expected revenues?

c. What are the sources of the expected revenues?

III. Needs

A. Short-run needs: 5-year plan

1. Needed maintenance for current and expanded facilities:

a. Physical?

b. Fiscal?

i. expected expenditures?

ii. expected revenues?

2. Expansion of system/facilities:

a. For population changes:

i. physical capacity?

ii. fiscal capacity?

b. For economic growth

i. physical capacity?

ii. fiscal capacity?

3. Stage of planning for these expansions?

a. Expected expenditures?

b. Projected revenues?

c. Sources?

B. Long-run needs to year 2000?

1. Needed maintenance for current and expanded facilities:

   a. Physical

   b. Fiscal

      i. expected expenditures?

      ii. expected revenues?

2. Expansion of system/facilities?

   a. For population changes:

      i. physical capacity?

      ii. fiscal capacity?

   b. For economic growth

      i. physical capacity?

ii. fiscal capacity?

3. Stage of planning for these expansions?

   a. Expected expenditures?

   b. Projected revenues?

   c. Sources?

For each estimate obtained, ask:

1. How accurate are these actual or estimated data?

   Ranges:

   1. 0-10%_____

   2. 11-25%_____

   3. 26-50%_____

   4. 51-100%_____

2. How are these estimates derived? Wherever possible, get written data sources, e.g., publications, to refer to when writing report.

3. Inflation factor--what is the base year of these estimates?

4. What are the major constraints on planning and implementation of these/this project? (fiscal, political, environmental)

Interviewee_____

'Position_____

Address_____

Phone Number_____

Interviewer_____

Date_____

Others who can assist_____

_____

_____

_____

_____

LIST OF REFERENCES

Louis Berger and Associates, Inc. 1980. New England Ports and Harbors Program: Inventory of Existing Port Facilities. New Jersey.

Bewick, John A. 1979. "Questionnaire to Document Extent of A.ed in Massachusetts." (April).

Byrd, Tallamy, MacDonald, and Lewis. 1982. A Report to the Massachusetts Special Commission on Highways. Virginia (April).

Central Transportation Planning Staff. 1979. Plan Refinement Study Final Report (Commuter Rail Improvement Program) (January).

Central Transportation Planning Staff. 1982a. Transportation Improvement Program, 1982-1986. (January 31).

Central Transportation Planning Staff. 1982b. Transportation Plan for the Boston Region, FY 1982 (June).

Comptroller General, Report to the Congress of the United States. 1980. "Additional Federal Aid for Urban Water Distribution Systems Should Wait Until Needs are Clearly Established." CED-81-17 (November 24).

Downs, Margaret, Abigail Egan, David Merkowitz, and Arthur Magida. 1982. Building A Water Policy Concensus: Key Issues for the Eighties. Washington, DC: Northeast-Midwest Institute (June).

Flynn, Robert. 1983. "Memorandum," Northern Middlesex Area Commission (April).

Fogarty, Bill. 1983. "Facing Up to Our Hazardous Waste Dilemma," Professional Engineer (Spring).

Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University. 1983. "Massachusetts Infrastructure Study: Survey Questionnaire."

Masnick, George, and John Pitkin. 1982. "Cohort Projections of School-Age Populations for States and Regions: 1985 to 2000." Cambridge, MA: MIT-Harvard Joint Center For Urban Studies.

Massachusetts Laws of the Commonwealth. 1979. Ch. 21, Sec. C (West).

Massachusetts Aeronautics Commission. 1980. Massachusetts Airport System Plan. Boston, MA (November).

Massachusetts Bay Transportation Authority. 1981a. Commuter Rail Summary Sheet (November 16).

Massachusetts Bay Transportation Authority. 1981b. Commuter Railroad Operation Study. 3 Volumes (June 15).

Massachusetts Bay Transportation Authority. 1982a. Annual Report 1981.

Massachusetts Bay Transportation Authority. 1982b. Budget 1983/FY1984 (October 1).

Massachusetts Bay Transportation Authority. 1982c. "Depreciation Schedule, June 30, 1981 to June 30, 1982."

Massachusetts Bay Transportation Authority. 1982d. Rail Equipment 1983 & FY1984 Budget Request (August 6).

Massachusetts Bay Transportation Authority. 1982e. "Railroad/Highway Grade Crossing Projects (1982-1983)," Summary Sheet (Revised).

Massachusetts Bay Transportation Authority. 1982f. Title VI Assessment for Capital and Operating Assistance (December).

Massachusetts Bay Transportation Authority. 1983a. "Track and Structures Report."

Massachusetts Bay Transportation Authority. 1983b. "Federal Funding Summary Sheet."

Massachusetts Bay Transportation Authority. 1983c. Management Report (January 21).

Massachusetts Bay Transportation Authority. 1983d. "1983 Commuter Rail Improvements to Existing Services Program."

Massachusetts Bay Transportation Authority. 1983e. "Railroad Operations Directorate."

Massachusetts Bay Transportation Authority. 1983f. "$10 Million Bond Program." Exhibit B.

Massachusetts Bay Transportation Authority. 1983g. "Treasurer's Office Department Costs." (Summary).

Massachusetts Department of Environmental Management, Bureau of Solid Waste Disposal. 1982. "Hazardous Waste Management in Massachusetts: 1982 Statewide Environmental Impact Report." Boston, MA (August).

Massachusetts Department of Environmental Quality Engineering, Division of Hazardous Wastes. 1982. "A Listing of Firms which have been Licensed to Collect, Store, and/or Dispose of Hazardous Waste in Massachusetts." Boston, MA (December).

Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control. 1980. "Wastewater Treatment Facilities." Boston, MA.

Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control. 1982. "Federal Construction Grants Project Priority List for Fiscal Year 1983." Boston, MA.

Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control. 1983a. "Memorandum: Boston Harbor Clean-Up." Boston, MA (February).

Massachusetts Department of Environmental Quality Engineering, Division of Water Supply. 1983b. "Leak Detection Grants (Summary Sheet)." Boston, MA (January).

Massachusetts Department of Environmental Quality Engineering, Division of Water Supply. 1983c. "System Rehabilitation." Boston, MA (January).

Massachusetts Department of Public Works. 1983. "Computer Printout: Rail Bridges and Tunnels." (April 15).

Massachusetts Division of Water Pollution Control. 1980. "Wastewater Treatment Facilities."

Massachusetts Executive Office of Transportation and Construction. 1977. Technical Supplement to the PMT, Vol. II (April).

Massachusetts Executive Office of Transportation and Construction. 1981. State Rail Plan 1980 Update (February).

Massachusetts Executive Office of Transportation and Construction. 1982a. Regional Transit Authority Operations Report 1981-1982.

Massachusetts Executive Office of Transportation and Construction. 1982b. State Rail Plan 1981-1982 Update (November).

Massachusetts Legislature. 1979. Massachusetts Acts 805.

Massachusetts Legislature. 1982. Massachusetts Acts 286.

Massachusetts Port Authority. 1981. The Port of Boston: A Maritime Strategy. Boston, MA.

Massachusetts Senate, Committee on Ways and Means. 1982a. "Budget Recommendations, Fiscal Year 1983: Policy Report 2, Management of Water Resources." Senate No. 1900, Boston, MA.

Massachusetts Senate, Committee on Ways and Means. 1982b. "Memorandum, Chapter 286 of the Acts of 1982." Boston, MA.

Massachusetts Special Legislative Commission on the Adequacy of Water Supply in the Commonwealth. 1979. "Report." House No. 5596. Boston, MA.

Massachusetts Special Legislative Commission on Water Supply. 1982. "Memorandum, Chapter 286, 1982." Boston, MA (July).

Massachusetts Turnpike Authority. 1981. Annual Report. Boston, MA.

Massachusetts Water Resources Commission, Division of Water Resources. 1982a. "Analysis of the Water Resources of the Commonwealth." Boston, MA (June).

Massachusetts Water Resources Commission, Division of Water Resources. 1982b. "Massachusetts Water Supply Systems: Source of Supply, Safe Yield, Type of Supply, Proposed Sources." Boston, MA (June).

Metropolitan District Commission. 1975. the EMMA Plan for Water and Wastewater.

Metropolitan District Commission. 1981. Annual Report, Fiscal Year Ending June 30, 1981. Boston, MA.

New England River Basin Commission. 1981a. Harbor Management Strategies for New England. Boston, MA.

New England River Basin Commission. 1981b. Prospects and Strategies for New England Ports. Boston, MA.

The Nova Institute. 1979a. The Northeast Water Resources Project, Volume I: Water Resource Priorities for the Northeast. Prepared for the Consortium of Northeast Organizations. New York, NY (September).

The Nova Institute. 1979b. The Northeast Water Resources Project, Volume III: The Economic Impact of Water Projects. Prepared for the Consortium of Northeast Organizations. New York, NY (September).

Old Colony Planning Council. 1983. "Response to Massachusetts Infrastructure Study Questionnaire."

The President's Intergovernmental Water Policy Task Force, Subcommittee on Urban Water Supply. 1980. "Urban Water Systems: Problems and Alternative Approaches to Solutions." Washington, DC (June).

The Road Information Program. 1982. "An Analysis of the Economic Benefits of a Highway Repair Program in Massachusetts." Washington, DC (August).

Southeastern Regional Planning and Economic Development District. 1983. "Response to Massachusetts Infrastructure Study Questionnaire."

Tabors, Richard D. 1979. "Utility Services." In The Practice of Local Government Planning, edited by Frank S. So, Israel Stollman, Frank Beal, and David S. Arnold., International City Management Association. Washington, DC.

U.S. Bureau of the Census. 1982. 1980 Census of Population. Volume 1, Characteristics of the Population, Chapter B, General Population Characteristics Part 23, Massachusetts. PC80-1-B23 (June).

U.S. Congress. 1974. Clean Water Act. PL92-500.

U.S. Department of Transportation, Federal Highway Administration. 1979. Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges. Washington, DC (January).

U.S. Environmental Protection Agency, Priority Needs Assessment Branch, Facility Requirements Division, Office of Water Program Operations. 1982. 1982 Needs Survey: Cost Estimates for Construction of Publicly-Owned Wastewater Treatment Facilities. Washington, DC (December).

Wallace, Floyd, Ellenzweig, Moore, Inc. 1978. "Massachusetts Water Supply Policy Statement." Prepared for the Commonwealth of Massachusetts, Executive Office of Environmental Affairs. Cambridge, MA (May).

○